MARCH 12, 1951

Electrical World

Price 35 Cents

A McGRAW-HILL PUBLICATION

Canadian utility converts to glass bulb rectifiers for transit power supply

See page 92

Power engineers can break mobilization bottlenecks

How does the **Murray** MAGNETIC BREAKER put *Security* in your Security Lighting?

Fully Magnetic

MAGNETIC ACTION GIVES **MURRAY** CIRCUIT BREAKERS TWO DISTINCT ADVANTAGES

1. After tripping to "off", service can be restored quickly.
In most cases, the use of Murray Breakers means that service can be restored 10 to 100 times faster than circuit protecting devices which do not employ fully magnetic action.

2. Murray Breakers always carry full load regardless of temperature.
Night and day, there are "hot" spots in any group of industrial buildings—overhead heaters, spot heaters, radiators, baking tunnels, furnaces, etc. Because Murray Circuit Breakers are fully magnetic, they trip only on short circuits or overloads. They always carry the full load, regardless of temperature. They never need "derating."

IF YOU WANT TO INSTALL THE BEST... specify *Murray*

MURRAY MANUFACTURING CORPORATION
1250 ATLANTIC AVENUE
BROOKLYN 16, NEW YORK

Service Entrance & Meter Equipment • Magnetic Circuit Breakers • Switches
Current Limiting Reactors • Crews'nest Aerial Ladders

Write for descriptive folder—clip out the coupon for the complete story of Murray Breakers and Load Centers.

MURRAY MANUFACTURING CORPORATION E-3
1250 Atlantic Avenue, Brooklyn 16, N.Y.

Please send me folder describing the Murray Circuit Breaker line.

Name _____

Position _____

Company _____

Address _____

WHAT'LL HAPPEN TO SALES?

Picture in your mind for a moment a meeting in the office of the president of a typical electric utility. In attendance are the president, the chief engineer, the superintendent of power plants, the purchasing agent, and the sales manager who apparently is on the carpet before the others. They say because of the country's shifting to a defense economy he'll simply have to cut out load building.

He agrees to this, but convinces them that sales effort and sales organization must be maintained.

In particular he explains what can be done with lighting, if the company should find itself without regular merchandise such as household appliances to promote.

This leads to an important question in the industry. What's going to happen to utility selling in the new economy? "Electrical World" presents an answer in the forthcoming issue. It's an 8-page commercial section and it includes an article prepared by the McGraw-Hill Department of Economics on the commercial horizon as it will probably affect the utilities.

Electrical World does its best to spot trends and to anticipate economic changes—and then to provide you with the alternatives for meeting them most effectively.

NEW NAME

We're changing the name of one of the regular departments of "Electrical World." Starting in the next issue, "Load Building" will become "Sales and Service." The first issue will see little change in this useful department except its name, but as time goes by we'll see that Sales and Service conforms to changing times in providing the most useful information possible for men in the commercial departments of the utilities.

How do we know what information these men find most useful? We asked them. A mailing of 112 questionnaires was made to sales executives in utility companies. As this is written we have received carefully considered replies from 80 of them. This is a return of 71%—a whale of a return in **any** survey. We asked these men to tell us the kind of information they'd like to read in a regular Sales and Service Department in "Electrical World." They took a lot of time and trouble to tell us, and we intend to make this department a useful one by their standards.

THE EDITORS

Electrical World

Published for 77 years for those engaged in the business of generating, transmitting, distributing applying electric power

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But be sure it's been proved too

There have been a lot of new ideas in cable materials and methods over the years—some good, some bad. New ideas often have limitations as well as advantages. The cable which has the *best balance* between the modern and the time-tested, is your best buy.

With Okonite, you can be sure it's modern—and be sure it's *field-proved*, too. For Okonite has constantly maintained the initiative in introducing techniques and materials to the electrical cable industry. Okonite's ultra-modern research facilities are ever abreast of the newest developments, and in 72 years have pioneered countless technological improvements.

But Okonite does not—*will* not—offer a new idea to you until its worth has been proved beyond all question. A new development must survive months... and years... of every conceivable type of testing before it is built into any Okonite cable.

These are some of the "firsts" which have successfully weathered Okonite's proving ground tests, and the ultimate test of prolonged usage. And, what's more important, these developments have given you cables of greater reliability and wider application to meet the complex and ever-increasing needs of the electrical industry.

FIRST—to introduce rubber-insulated power cable for 35,000-volt service (Okolite)
FIRST—to produce American shock-proof, high voltage rubber-insulated x-ray cables (Okolite)
FIRST—to use neoprene in cable sheathing (Okoprene)
FIRST—to develop (Okoseal) synthetic impervious sheath (PVC) for Navy shipboard cables, now used by the industry in many types of wire
FIRST—to use glass as a wire insulation—quickly adapted by electric motor manufacturers for magnet wire (Okoglass)
FIRST—to introduce high-pressure pipe type cable system for high voltage transmission circuits (Oilostatic)
FIRST—to use semi-conducting tape between conductor and insulation to prevent internal corona-cutting (Semicon Tape)
FIRST—to develop "line-tap" reverse-lay self-supporting aerial cable (Dualay)
FIRST—to introduce all-rubber underground cable (Okosheath)
FIRST—to introduce small diameter building wire to solve problem of rewiring raceways (Okoseal)

When you have a cable problem, ask your Okonite representative to help you choose the most effective cable to meet the job requirement or write directly to The Okonite Company, Passaic, N. J.

THE BEST CABLE IS YOUR BEST POLICY

OKONITE SINCE 1878 *insulated wires and cables*

8638

From a single near-by source

Everything for Transmission Lines

— AND ALL OTHER LINES

From near-by Graybar you can fill all your transmission-line material and supply requirements with just one order – and be sure you're getting dependable items. You save time and expense. You get the products of leading manufacturers of poles, crossarms, insulators, hardware, strand, line trucks, and tools.

When you call Graybar, for supplies or for information, your needs are understood and accurately met. That's because Graybar has been familiar with pole-line requirements ever since the first lines went up.

Your local Graybar Representative is ready to provide product and delivery information about any of the more than 100,000 electrical items Graybar distributes. In addition, a Graybar Outside Construction Specialist is ready to apply his knowledge, gained through years of specialized experience, in helping you to solve unusual transmission-line problems of all types. He will also be glad to work with you in solving problems that come up in planning other line construction, maintenance, or underground projects. ***Graybar Electric Company, Inc. Executive offices: Graybar Building, New York 17, N. Y.***

116-93

IN OVER 100 PRINCIPAL CITIES

You get the best of everything electrical

Via GraybaR

This Megohm Bridge with a

Range of **0.1 to 1 Million Megohms**

is the Ideal Means for Measuring . . .

★ Insulation Resistance of Generators, Motors and Transformers

Paper Capacitors ★ Long Sections of High-Voltage Cable ★ Single Conductors, Cables and Capacitors

★ Slabs of Insulating Material ★ Volume Resistivity and its Change with Temperature and Humidity

★ Multi-Wire Cables ★ Dielectric Absorption in Insulation of Electrical Machinery

★ Taking Charge-Current Curves Over Time Intervals from One Second to Many Hours

The G-R Type 544-B Megohm Bridge is, fundamentally, a Wheatstone Bridge with a very sensitive vacuum-tube voltmeter balance-indicating circuit, which absorbs a negligible amount of power.

Over the range from 100,000 ohms to 10,000 megohms, the effective scale length is 35 inches. The accuracy of measurement varies from ± 3% from 0.1 megohm to 100 megohms, to ±10% from 1,000 megohms to 10,000 megohms.

Two power supplies are available; an a-c unit delivering d-c test voltages of 500 volts and 100 volts to the bridge, and a battery supply of 90 volts. The voltage applied to the unknown resistance is very close to constant, regardless of the value of the unknown resistance.

Type 544-B MEGOHM BRIDGE for A-C Power use . . . $340.00
for Battery Operation (including batteries) . . . $250.00

WRITE for COMPLETE INFORMATION

GENERAL RADIO COMPANY Cambridge 39, Massachusetts

90 West St., New York 6 920 S. Michigan Ave., Chicago 5 1000 N. Seward St., Los Angeles 38

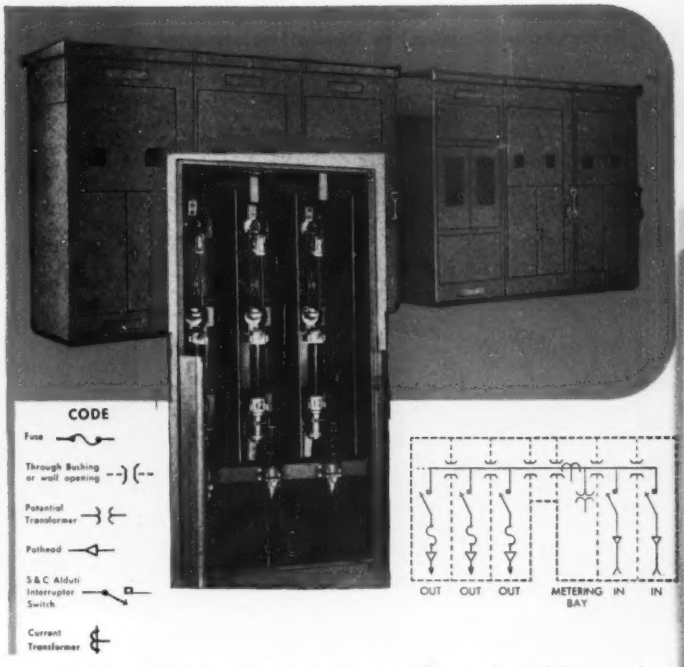
Saving Money

...with high voltage electrical distribution?

S&C Switchgear Units offer *30-60% savings* on substations and load centers

If you're planning to revamp your electric power system to get shorter cable runs, lower line losses and better voltage regulation, don't miss this opportunity to save money on equipment costs also. S&C Switchgear Units for modern high voltage switching stations, unit substations, and load centers have high interrupting capacity, and also offer large savings over circuit breakers.

Utilizing Alduti Interrupter Switches and SM Power Fuses, S&C Switchgear Units provide the switching performance and short circuit protection described below, right. In addition they provide:



One-package (unitized) metal-enclosed construction.

Ease and economy of installation because all equipment within each unit is factory assembled and connected. Incoming and outgoing connections are readily accessible.

Minimum maintenance expense since a blown fuse is fully restored by simple field replacement of its refill unit. Moreover, under usual conditions the switch requires no maintenance.

Service continuity since the reliability of S&C Power Fuses eliminates outages from surge-caused "sneakouts."

48-page booklet is yours for the asking. Consult telephone directory for S&C representative or write us direct.

Typical Performance Characteristics of S&C Switchgear Units

	VOLTS	SHORT CIRCUIT PROTECTION
	2,300 to 34,500	Expressed in 3-Phase KVA
	AMPERES	
Switches:	600, continuous and interrupting	104,000 at 2,400 volts
Fuses:	400, continuous, to 15,000 volts	180,000 at 4,160 volts
	300, continuous, to 34,500 volts	448,000 at 13,800 volts
		715,000 at 33,000 volts

S&C ELECTRIC COMPANY

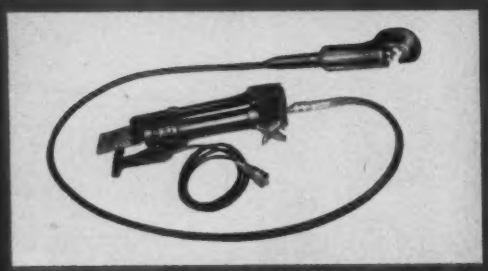
4421 Ravenswood Avenue
Chicago 40, Illinois, U. S. A.

Formerly SCHWEITZER & CONRAD, INC.

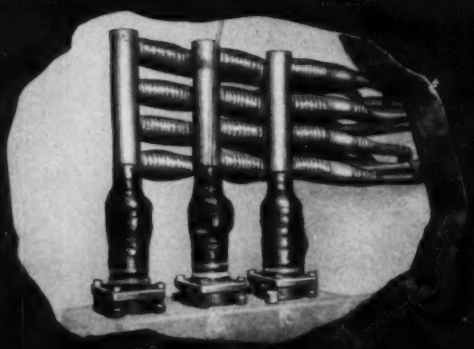
In Canada: Powerlite Devices, Limited, Toronto

BURNDY MOLE LINE EQUIPMENT for

You're *always prepared* to add new loads to your underground secondary electrical distribution system *rapidly* and *economically* if you install Burndy Mole Line Equipment *from the start*. Engineered to speed up and simplify the connecting of underground cables, Burndy Mole Line Equipment also provides cable protection as well, simply by adding Limiters and Molimiters. That's why Burndy Mole Line Equipment is the *basic connecting system* for utilities that look to tomorrow —*today*.

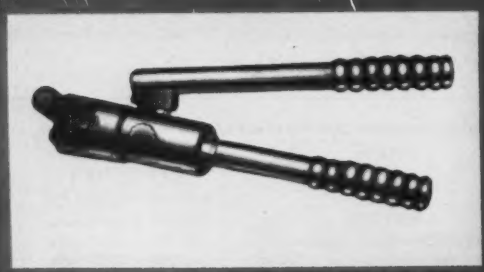


Burndy *foot-operated* hydraulic HYPRESSES install Hycrabs and Hydent connectors on conductor sizes No. 8 through 2000 Mcm. Automatic overload valve controls depth of indentation.



Combination insulated Burndy Stud Mole for terminating copper cables to network protector. Cables are protected by connection to the Stud Mole through Burndy Limiters.

BURNDY HYCRABS are HYPRESSED for



Burndy *hand-operated* hydraulic HYPRESS installs Hycrabs and Hydent connectors on underground cables No. 6 through 500 Mcm. Covered with Neoprene, it is specially suited for close quarters. Develops 9 tons of total force.

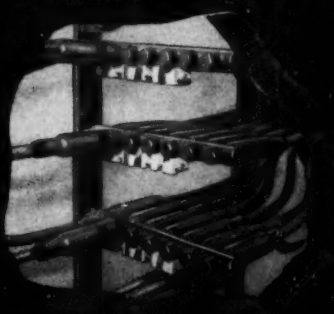
This Burndy Limiter Stud Connector joins four 500 Mcm. cables to the network protector, each cable protected by a fusible section enclosed in an Asbestite shell.

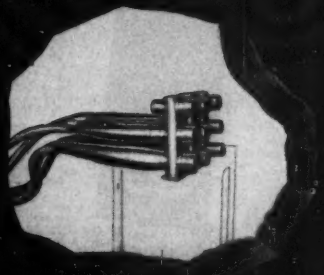
BURNDY

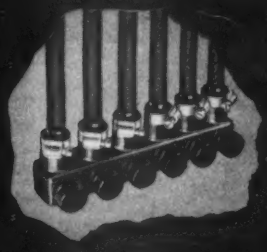
New York 54, N. Y.

Burndy Canada Ltd., Toronto 8, Ont., Western Branch, Vernon 58, Cal.

orderly, economical UNDERGROUND expansion



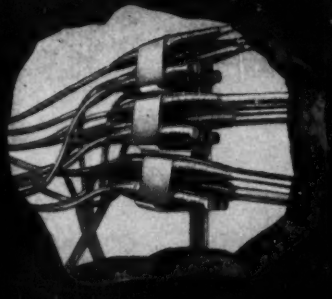


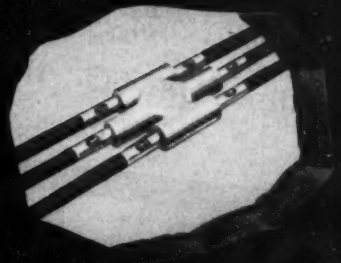


Burndy Molimiters and Moles are used together for cable connection and protection at junction points. Note outlets reserved for future expansion. Burndy Moles and Molimiters are supplied in sizes and types to suit all connection needs in the secondary network.

The Burndy KME Mole is particularly suited to the type of underground system employed in high grade residential areas. Supplied in sizes having 8, 6, or 4 outlets accommodating conductors from No. 8 through 250 Mcm.

quick, low cost connections UNDERGROUND





Burndy Limiter Hycrabs provide limiter protection to cables joined at a single junction point by means of quick, economical Hypress indent connections. Fusible elements have asbestite shell arcing chambers. Entire assembly is insulated.

Burndy Hycrab YM is a compact, multiple, fully insulated crab joint that connects underground cables 4/0 through 500 Mcm by means of Hypress indent connection. Supplied with 4 to 12 outlets. Reserve outlets can be sealed with easily removable plugs.

ADVERTISEMENT

WE MADE several attempts to write a conventional ad telling you about the new Line Post insulator. It just couldn't be done. There wasn't space to tell the story and the unsupported claims for this new insulator sounded too strong to be believed. What we really would like would be to sit down at your desk with a sample of the Line Post and talk it over with you for a few minutes. So, if we may invite ourselves in, let's pretend we are doing just that, using the photograph as a poor substitute for the insulator.

The Line Post is used wherever pin type insulators are used. It sets directly on the cross arm and is held in place by a center stud attached to the malleable iron base, and going through the cross arm like the stud of an ordinary pin. The conductor rests in the groove in the top and is tied in place in the usual way. Strength is the same as that of an ordinary insulator and pin.

66-KV. LAPP LINE POST

The insulator, as you see, consists of a porcelain post which is cemented into a base. There are two or three important points along this line. The porcelain is *one piece* and is hollow, the hole being closed at the top by a thick section of porcelain. The base grips the porcelain from the outside only. There is nothing within the insulator. The hole is closed at the lower end by a rubber plug slipped in place before cementing. The insulators come equipped with the stud and need no pin. The base is designed for use with flat arms. For crowned arms a routing washer may be used.

Now that you know how it is used and something as to the way it is made you are probably wondering, "Just how will this insulator help me?" Well, in many ways, but suppose we tell you by going over the various characteristics that most people would like to have in their pin type insulators and see how the Line Post meets them.

RADIO INTERFERENCE—The Line Post *produces no interference* at the rated neutral voltage with a margin of safety ranging from 20% for the 66 Kv size to about 100% on the smaller ones. Loose or dirty tie wires do not lower this starting voltage very much, thanks to the new tie head. Briefly, the high voltage at which interference (and corona) starts is due to the small amount of charging current which this insulator requires. In other words, it has a very low capacitance—about one tenth that of an ordinary unit. The low capacitance results from the wide separation of the live terminals. *Freedom from interference comes from the design itself and does not depend on special treatments or coatings many of which have already proved to be temporary in nature.**

PUNCTURE is almost impossible in the Line Post because the puncture path is practically the same length as the flashover path. The insulator will invariably flash over. The duty on the porcelain is very mild and no thin section can be subjected to high electrical stress.

CRACKING—Insulator cracking results from the porcelain being loaded in tension. Some bursting force from within becomes so great that the porcelain can no longer bear it and the shell cracks. In the Line Post there is nothing within the insulator to exert such bursting forces. The hardware is cemented externally to the one piece porcelain with a large area, low intensity compression grip. Temperature changes between the base and porcelain can load the porcelain only in compression and it is very strong (50,000 to 75,000 pounds per sq. inch) in compression. *A most important point is that the safety of the Line Post comes from the design itself and does not rely on special treatments, test or assembly methods.*

BEHAVIOR UNDER POWER ARCOVER—Until we learn how to build lines which will never flash over the ability of the insulator to go back in service after power arcover will be important. The Line Post gets its leakage and flashover distance from many short, sturdy flanges rather than from broad, spreading shells. Tests and operating experience show that short petticoats of this type are much less subject to damage than are the large ones. If under most severe conditions one or two flanges are lost you can see that the flashover and leakage distances are lowered very little.

MECHANICAL ATTACK—The same qualities that make this insulator behave well under power arcover protect it from serious damage under mechanical attack. Tests show that stone and shot gun attacks at reasonable distances will do no damage. Rifle fire may rip off a petticoat. But—you haven't lost any appreciable percentage of the electrical characteristics and the insulator will surely stay in service. The leakage distance for a given rating is originally about 50% greater than that of a conventional insulator.

DIRT CONDITIONS—Six years experience with Lapp Fog Type insulators leaves no doubt as to the effectiveness of this type of leakage surface for such conditions.

APPLICATION—The Line Post may be used in either new or existing lines. *In all respects it is a general purpose insulator.* There are, however, certain locations in which it is especially appropriate to try out these units. Field experience indicates that insulator radio interference does not travel far along the line. It is an entirely practical matter to replace present units in a residental area with Line Posts, correcting local conditions and using the old insulators for maintenance. This can be done at very little cost over that necessary for regular operation. They may also be used to correct dirt conditions, in locations where mechanical breakage is severe or where lightning flashovers are common.

Based on over two years' completely successful operating experience under a wide range of climatic conditions, these insulators give promise of permanently correcting many of the defects of conventional insulators. We urge you to give these insulators a trial under the worst conditions on your system.

Ask for Bulletin No. 112 with full details and catalog information.

Thanks for your time and attention.

*see paper, "A New Porcelain Post Insulator" by G. W. Lapp

LAPP INSULATOR CO., INC., LEROY, N. Y.

THIS IS THE FIRST ADVERTISEMENT OF THE LAPP LINE POST TO APPEAR IN ELECTRICAL WORLD

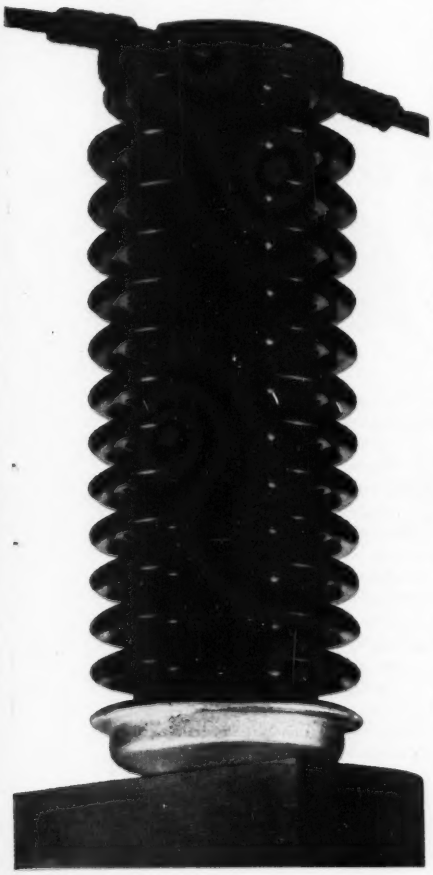
The Lapp LINE POST has a 20-YEAR service record

IT WAS "STRONG TALK" THEN . . .

. . . IT'S A PROVED RECORD TODAY!

If you've been a regular reader of Electrical World for 20 years, you probably saw the advertisement reprinted across the page. You probably agreed that such "unsupported claims for this new insulator sounded too strong to be believed."

But you may have read on, down to the punch-line "We urge you to give these insulators a trial under the worst conditions on your system." You might even have had a condition so bad that you were willing to give this untried and "radical" design a trial. If so, you can write the rest of this particular advertisement as well as we can. For a lot of fine engineers in a lot of fine companies *did* act on that suggestion. Never did an insulator have a more severe baptism-under-fire, nor a better chance to prove its merit. Wherever lightning was worst . . . wherever kids shot down insulators as fast as maintenance crews could put 'em up . . . wherever radio interference drowned out Amos 'N Andy . . . wherever scrub-brush-and-bucket brigades couldn't keep up with salt fog or industrial contamination . . . wherever insulation of transmission lines was next-to-impossible duty for conventional insulators, Lapp Line Posts got a trial.



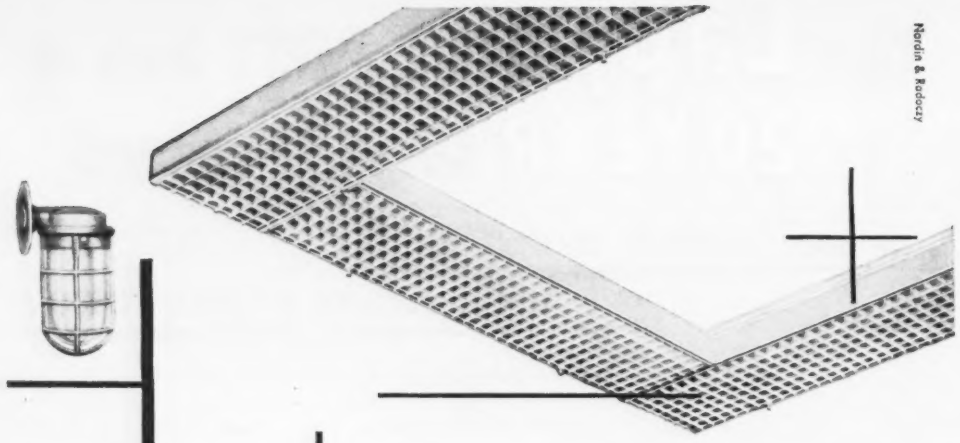
What's the record of accomplishment? Why, most of the companies that made those early "trouble-spot" trials are the companies which have long since standardized on Lapp Line Posts.

There isn't anything we were saying about Lapp Line Posts twenty years ago that we haven't been saying since, and aren't saying today . . . *except* that . . . *the unsupported claims of 1931 are accomplishment proved by the record in 1951.* And that, in hundreds upon hundreds of long-service installations, the record proves that *lines on Lapp Line Posts have fewer outages, require fewer insulator replacements and less maintenance than comparable lines on any other type of insulator.*

You, too, will have fewer service interruptions . . . you'll save on manpower . . . you'll reduce maintenance costs . . . when you write into your transmission line standards and specifications "*Lapp Line Posts.*"

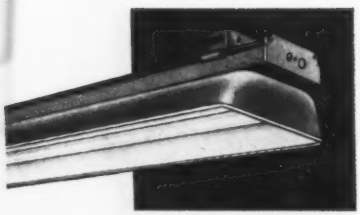
Lapp

LAPP INSULATOR CO., INC., LE ROY, N.Y., U.S.A.



Nardin & Radocay

HOW TO BE SURE YOU GET LIGHTING VALUE



Make sure of the answer to two questions:
What will it do for me? And — what will it cost?
Here are Miller's answers to both.
Miller lighting equipment — Fluorescent, Incandescent,
and Mercury-vapor, covering a wide range of industrial
and commercial requirements — will give
you high lighting efficiency, and years of service.
It is built on an 8-Point QUALITY standard, with rigid "Truss"
construction, certified components, Bonderite-treated steel, and long-life finishes.
Three elements must be considered in figuring cost —
first cost, installation cost, maintenance cost — overall cost.
Miller lighting equipment has engineering features
which make for easy installation and maintenance,
which explain its LOW OVERALL COST.
You can light with confidence the *proven* Miller way.
Miller field engineers and distributors are
conveniently located for nation-wide service.

THE miller COMPANY MERIDEN, CONN.
SINCE 1844

ILLUMINATING DIVISION: Fluorescent, Incandescent, Mercury Lighting Equipment
HEATING PRODUCTS DIVISION: Domestic Oil Burners and Liquid Fuel Devices
ROLLING MILL DIVISION: Phosphor Bronze and Brass in Sheets, Strips and Rolls

NEW Rotating Regulator

REGULEX
GENERATOR
VOLTAGE REGULATOR
POWER PLANT CONTROL

1 Minimizes the effect of disturbances caused by sudden load changes and fault conditions.

2 Controls generator excitation so as to increase safe operating limits.

3 Provides proper division of reactive current between synchronous machines operating in parallel when a cross current compensator is applied.

4 Provides accurate, sensitive voltage control.

5 Functions without hunting.

6 Provides high rate of excitation voltage response to restore voltage to normal as quickly as possible after a disturbance.

7 Provides alternate manual control of excitation without disturbance of the existing excitation.

WHEN SELECTING generator voltage regulators for your power plant, consider these seven big advantages of new *Regulex* control. Remember that *Regulex* control gives you pin-point accuracy while improving service continuity by reducing outages for maintenance. You can use *Regulex* generator voltage regulators on alternators, synchronous condensers and dc generators. Call your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin for further information.

A-3298

Regulex is an Allis-Chalmers trademark.

ALLIS-CHALMERS

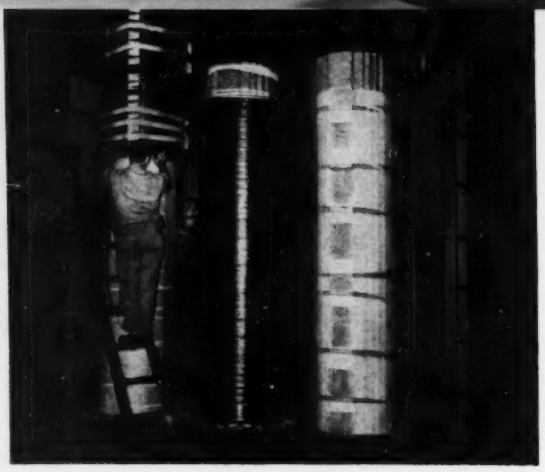
Order Telegraph Systems

The Allis-Chalmers Order Telegraph System is accurate and reliable . . . can be depended upon even during station power failure because it uses the dc bus for its power source. An alarm system operates until the order is returned correctly. Five or ten inch semi-flush dials for switchboard mounting. Use it to transmit orders between switchboard and turbine room.

Automatic Speed Control for Boiler Draft Fans

Draft fans operate at exactly the required speed for perfect combustion when Allis-Chalmers Type 257 Liquid Rheostats are used with wound rotor drive motors. They are application engineered to provide straight line speed characteristics . . . automatic wide range stepless speed control. Use electric, pneumatic or hydraulic pilot devices. Ask for leaflet 14S7544.

1 PLANNING BEST WAY to expedite vital 20,000 kva power transformer from drawing board to installation, A-C engineers Maise, Ashbaugh and Cook review specifications.



2 20 TONS of high-grade electrical steel is built into core. Core is 5-legged double magnetic circuit design, to keep tank height low. Cap protects low voltage coil from abrasion as it is lowered on core leg.

20,000 KVA TAKES LOAD OFF SOUTHWEST'S SHOULDERS

3 TO WITHSTAND PRESSURE of tons of oil, tank seams will be tested at a vacuum of 28" mercury. Submerged arc welding process produces a controlled, continuous weld.

FROM AIR CONDITIONING SYSTEMS for skyscrapers to mile-deep oil wells, new commercial and industrial load requirements placed a heavy burden on the power distribution system of an expanding Southwest city.

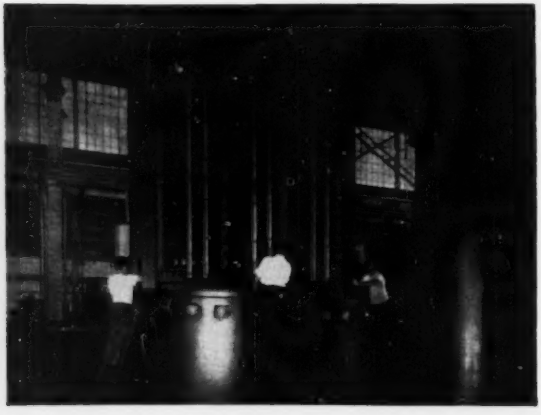
Until . . . this 20,000 kva Allis-Chalmers power transformer was installed to serve the downtown network area, and several outlying substations.

Whether 20,000 kva or the world's largest physical size transformer, such as recently completed, Allis-Chalmers has the engineering experience and facilities to build power transformers of *any* rating . . . to meet *any* system needs.

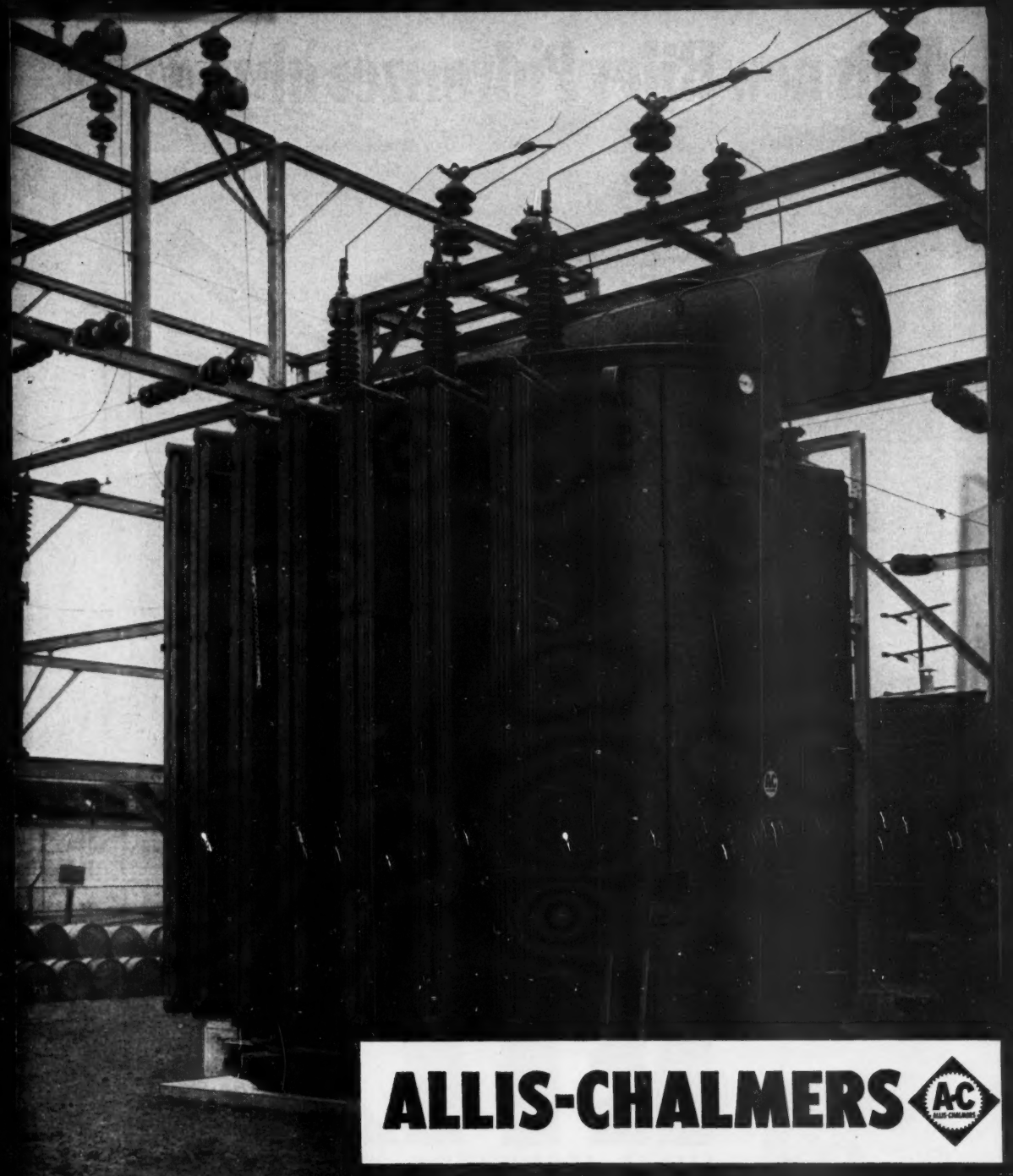
A-2982

ALLIS-CHALMERS, 932A SO. 70 ST.
MILWAUKEE, WIS.

4 HUGE 400 TON HYDRAULIC PRESS assures a high degree of accuracy in fabricating bosses, frames, covers, etc. Press is also used to dome cover so that it will shed water.



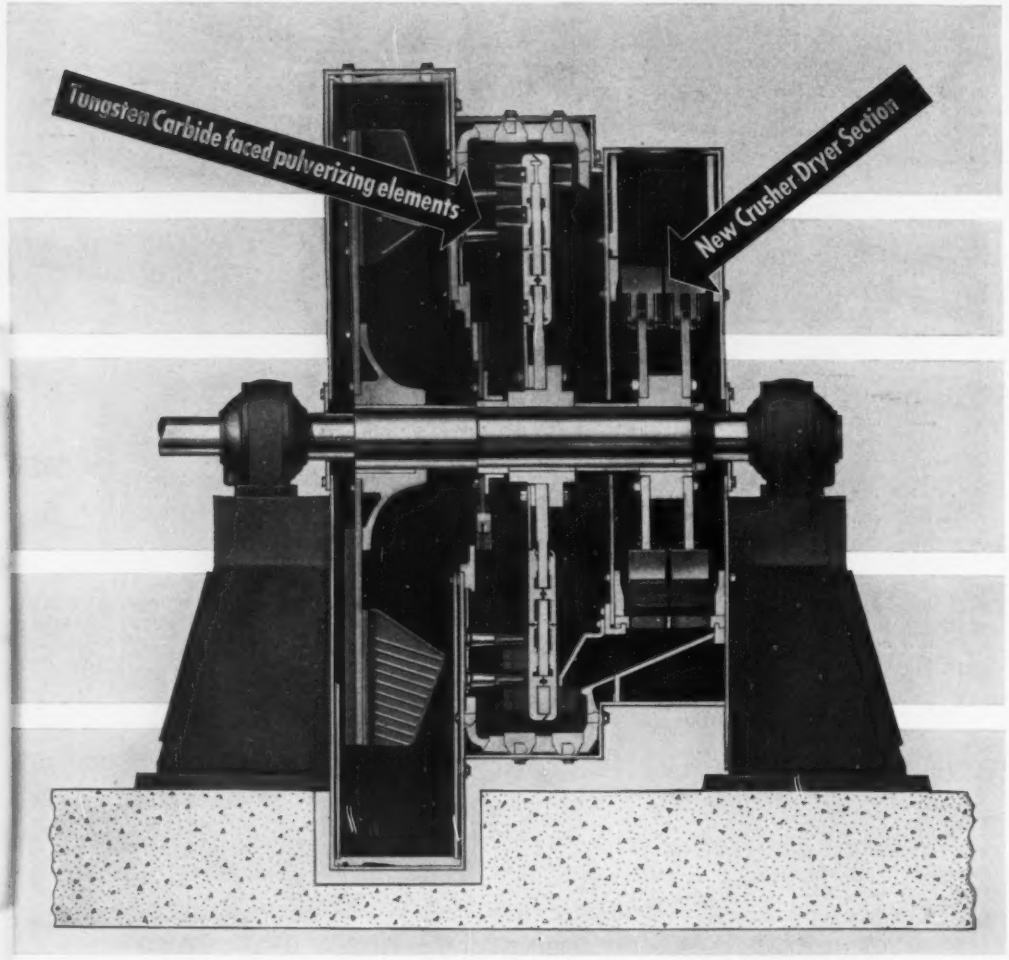
5 DOWN SHE GOES for a preliminary fit. This permits faster tanking after dry-out to maintain high dielectric strength of insulation. Notched end plates guide and accurately position assembly.



ALLIS-CHALMERS

6 MORE POWER TO SOUTHWEST! Not alone relief from heavy power demands today, but faithful power for years to come. The specifications: "20,000 kva, 3-phase, 60-cycle. 55°C rise, *Oil-Sealed* inert gas system, 66,000 volts Y to 13,800 volts Delta" . . . as fine a power transformer as years of engineering background can produce! *Oil-Sealed* is an Allis-Chalmers trademark.

This new Riley Pulverizer gives you



TRADE MARK
Rx
REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Atlanta New Orleans Memphis St. Louis Kansas City St. Paul Tulsa Houston
Denver Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

these added significant advantages

No capacity reduction with increase in moisture.

In the crusher dryer section where coal is crushed to a fine granular state, approximately 40% through a 50 mesh screen, representing about 5% of the work to be done, free moisture is evaporated from coal. The crusher dryer section acts as a flash dryer. Coal then enters pulverizing section where 95% of the work is done, completely free of moisture which would affect pulverizer performance and capacity. The crusher dryer section is designed with ample capacity for the highest moisture coals and as moisture is evaporated before coal enters the pulverizing section, moisture has no effect on pulverizer capacity or performance.

Tramp iron, iron pyrites and other foreign materials in coal rejected.

The crusher section of the pulverizer rejects tramp iron, iron pyrites and other hard foreign substances in the coal, preventing any materials from entering the pulverizer section which could cause damage.

Pulverizing elements faced with tungsten carbide.

Pulverizing elements are faced with tungsten carbide, assuring long periods of service without outage for maintenance and resultant low maintenance costs. Numbers of Riley pulverizers equipped with tungsten carbide faced parts have been in operation over two years without showing appreciable signs of wear, indicating at least several additional years of service before replacements are necessary. Over 50,000 tons of coal have been pulverized by a mill having a six-ton per hour capacity with indications that well over 200,000 tons will be pulverized before requiring replacement.

Fineness sustained over years of operation.

Because the life of the tungsten carbide faced pulverizing elements is so long, fineness of pulverization is maintained over years of operation. Tests on existing installations show no falling off of fineness after over two years of operation. No adjustments are necessary to maintain fineness.

Unusually high capacity per unit of space.

The improved Riley pulverizers have an unusually high capacity per unit of floor space and height, permitting their installation under crowded space conditions. A Riley Pulverizer having a capacity of 20 tons per hour with 50 grindability high moisture coal is only 11'9" wide, 10'0" deep and 7'6" high and weighs only 46,780 lbs. Because of their lower weight and quiet vibrationless operation, heavy foundations are not required.

If you are interested in coal pulverizers, we believe you will find the article "THE USE OF TUNGSTEN CARBIDE IN COAL PULVERIZERS," presented at the fall meeting of the A.S.M.E., well worth reading. We will be happy to mail a copy to you without charge on request.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprising [illegible] costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS WATER-COOLED FURNACES • STEEL-CLAD [illegible] SETTINGS • AIR HEATERS

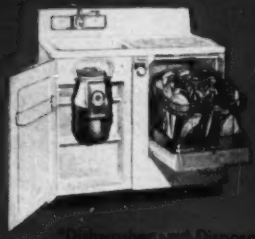
Today is the time to Sell Tomorrow's Customer!

The Hotpoint House of the Fifties on Plandome Hills, L. I., New York, is the most electrified home ever built ... the fulfillment of a dream to make complete electric living a reality and within the reach of everyone. A symbol of Hotpoint's forward planning, it marks the beginning of an era when Push-Button Electric Living becomes part of the American way of life.

Hotpoint is taking the lead to elevate today's low saturation appliance to the level of broad public demand.* To the utility, too, plus Hotpoint's leadership in today's demand appliances, means load insurance for the future ... for the day when wider usage of electric appliances will be needed to build and balance load.

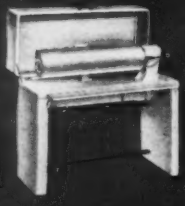
*Automatic Clothes Dryer Saturation less than 2%

*Food Freezer Saturation less than 8%



*Dishwasher and Disposall® Saturation less than 2%

*Automatic Clothes Washer Saturation less than 10%



*Rotary Iron Saturation less than 9%

Hotpoint LOOKS AT TOMORROW TODAY

LIVE ELECTRICALLY

UTILITY DIVISION

Hotpoint Inc.

(A General Electric Affiliate)

SYLVANIA'S greatest light-bulb premium offer is really going to town...

Get on board FOR PROFITS NOW!

No doubt about it, the new Sylvania all-purpose shears is the most tempting premium ever offered.

These shears, useful in garden, kitchen, and household, are wanted by every housewife. Worth at least $1.29 . . . offered for only 50¢ plus the outside carton of a Sylvania 4-Pack Mailed direct to purchasers.

Nationally advertised premium

Helping spread the news about this popular Sylvania premium is big-space advertising in 4 national magazines: *Better Homes and Gardens, Good Housekeeping, Look,* and *McCall's Magazine.*

Featured on big TV show

Telling millions more about this special offer is the nation-wide, weekly Television Show, "Beat the Clock".

FREE colorful displays . . . ad mats

Now's the time to tie in with this national program. Sylvania offers big, FREE, colorful store and window displays which tell about the shears offer at a glance. FREE ad mats, too, all ready to send to local papers.

So, don't delay. Call your Sylvania bulb representative for full information or mail the coupon TODAY!

SYLVANIA ELECTRIC

SYLVANIA ELECTRIC PRODUCTS INC. 1901–1951 FIFTY DECADES 50 ANNIVERSARY OF PROGRESS

Sylvania Electric Products Inc.
Dept. L-7103, 1740 Broadway
New York 19, N. Y.

I'd like to know more about Sylvania's big all-purpose shears promotion program.

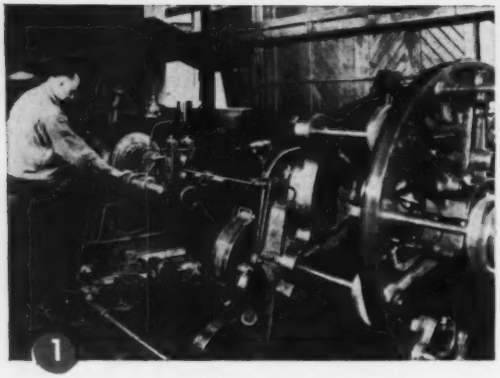
Name_____

Store_____

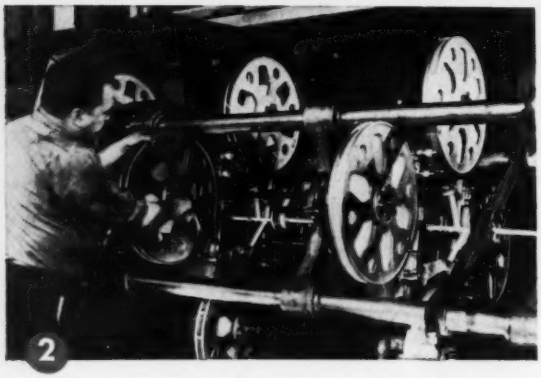
Street_____ Zone____ State____

City_____

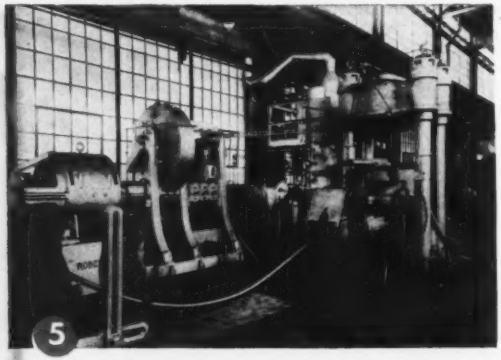
LIGHT BULBS; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; PHOTOLAMPS; TELEVISION SETS



Here, after being cleaned, drawn and annealed, the wire is laid-up into strands. Bare wire is on spools at far end of machine. If sector conductors are being made, they pass through special rolls that give the required shape to the conductor.



This is the paper taping head on our paper-insulating machine. Notice the accurately-machined rollers that apply shielding or paper tape, under tension, just where it belongs. Each layer of tape is butted—succeeding layers are carefully staggered so that butts are not adjacent.



Applying the lead sheath is one of the most critical operations. Lead pots are kept under a positive pressure blanket of carbon dioxide gas at all times to prevent the formation of dross and to provide clean welds; also, ducts and press containers are flushed before each charge. Mechanical lead skimmers are used, along with automatic die block temperature recorders. Each charge is cooled under full hydraulic pressure to provide a dense homogeneous sheath.

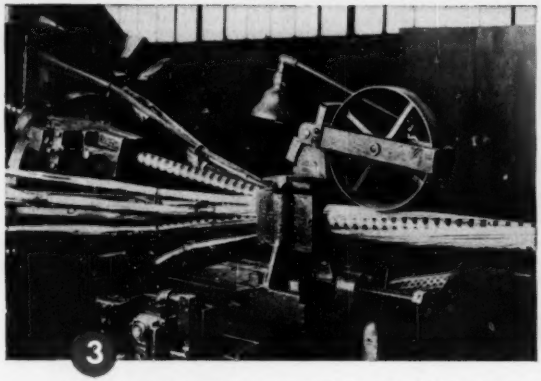
HERE'S HOW WE BUILD

American

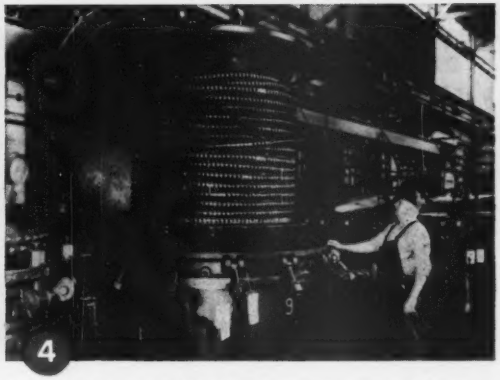
AMERICAN STEEL & WIRE COMPANY
USS
AMERICAN ELECTRICAL WIRE AND CABLE
UNITED STATES STEEL

After the sheath is checked for thickness, concentricity and cone bursting strength, tests are made of conductor resistance, high voltage strength, ionization, insulation resistance and bending resistance. High voltage cables are given a high voltage time test, dielectric power loss test and power factor test.

In she goes! The finished cable is shipped only after it has successfully passed every test mentioned here—and many more. Now the American Cable is ready for year after year of trouble-free *service*.



When the sector conductors are insulated and shielded, they go through this closing die—along with the paper filler strips. Special dies and guides are used to assure that each component is *exactly* in place.



After the cable is assembled, it goes to the saturating tank where it is heated under very high vacuum. Certain high-voltage cables are also "washed" with bone-dry carbon-dioxide to remove every trace of moisture. Then, impregnating compound is pumped in until cable is thoroughly saturated.

LONGER, TROUBLE-FREE LIFE INTO

Paper Insulated Cables

This step by step picture trip through our mill tells the story

U·S·S American Paper Insulated Cables are well known for their long, maintenance-free service life. Lots of people have wondered how we make them that way. This picture-trip shows some of the highlights in our carefully-controlled manufacturing process.

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM, SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

American Electrical Wire & Cable

UNITED STATES STEEL

Look INTO THE POLE STAR

AND SEE WHY IT IS FAST BECOMING A *Best Seller*

Sealed Tank Construction Throughout

All gaskets used in the Pole Star are made of synthetic rubber. A retaining ring in the cover keeps the gasket in its properly compressed position at all times.

No Pockets On The Pole Star

Side-issuing bushings on all Pole Star Transformers, 5000 volts and below, are straight, stud type. This permits the use of lathe-turned bushings on the Pole Star to assure greatest mechanical strength.

Tap Changes Made From Above Oil Level

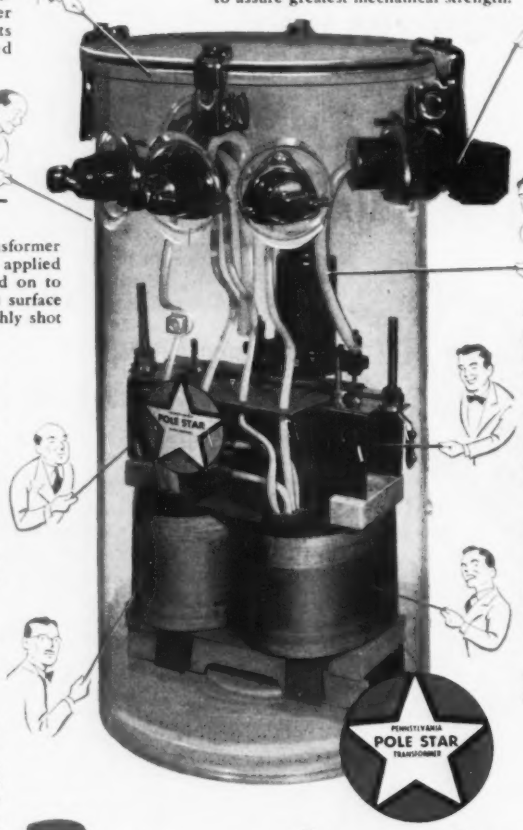
The tap changer handle is above the oil level, where tap changes can be made with great ease by turning the handle to the proper tap position. White letters on black bakelite clearly show the tap positions.

Shot Blasted— *Then Painted*

Three coats of transformer paint are individually applied and individually baked on to the tank *only after* the surface of the tank is thoroughly shot blasted.

Low Noise Level

The amount of contact pressure between laminations in the Pole Star core is not important because each lamination is actually a core itself. As a result, the noise level in the core is fixed at a low value and will not change.



Low Exciting Current

Laminations in the Pole Star core are individually lapped. The large cross section at the lap reduces the density and prevents a concentration of flux. As a result, the reluctance of the magnetic circuit is low. Each lamination forms its own magnetic path undisturbed by butt joints and points of high density.

Coils Wound Independently of The Core

Separate winding allows each coil to be tightly wound and individually treated to give it great mechanical strength.

Core and Coil Units Easily Taken Apart and Rebuilt

If a coil is damaged by lightning or excessive overloading, cores can be taken apart and rebuilt with replacement coils. This can be accomplished without appreciably affecting the low core loss or exciting current of the Pole Star.

P.S. Let the POLE STAR be your guide . . .

Product Of Long Experience — Safe Thrifty And Reliable

Pennsylvania TRANSFORMER COMPANY

Canonsburg, Pennsylvania — Greater Pittsburgh District

Now available!

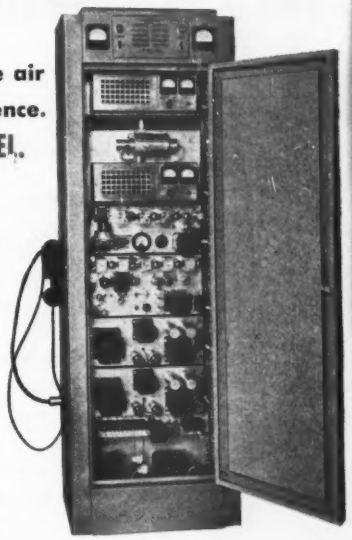
450 MEGACYCLES... FOR THE PUBLIC UTILITY FIELD and GENERAL MOBILE SERVICES

Link

450-MC MOBILE RADIO EQUIPMENT
(RADIO TRANSMITTER-RECEIVER
TYPE 2210-ED.2
WITH CONVERTER TYPE 2581)

450 megacycle 2 WAY-RADIO

...insuring PRIVACY on the air and freedom from interference. Features LOW NOISE LEVEL.



100-WATT 450-MC
MAIN STATION
TYPE 2340-TR (100 W)

EXCEPTIONAL PERFORMANCE has been obtained with the *new* LINK 450 megacycle land-mobile radio equipment, rating it as definitely *superior* to equipment operating in the 152-174 mc. band in urban areas such as New York City. The low man-made noise level on the 450 megacycle band is especially noticeable and contributes appreciably to the excellent performance in metropolitan areas.

LINK RADIO'S years of experience in building equipment in this frequency range are now applied to developing and producing the first commercial mobile equipment on the new band for use by the general mobile service.

Encouraged by the F.C.C.'s whole-hearted approval for the manufacture of 450 megacycle equipment, LINK RADIO is now in full production on two-way land-mobile radio systems operating in the 450-460 mc. band allocated by the F.C.C. to the Land Transportation, Public Safety, Remote Pick-up Broadcasting, Industrial and Domestic Public services.

● For full particulars, please write to Dept. E, Link Radio Corporation

LINK RADIO CORPORATION 125 W. 17th St., New York 11, N.Y.

Designers And Manufacturers Of Electronic Communications Equipment Since 1932!

SALES OFFICES IN THE PRINCIPAL CITIES OF THE UNITED STATES

International L-120 (GVW 5,400 pounds) with a new, special-design service body. Body features include: built-in trays and weather-tight compartments; doors with slam-action catches and cylinder locks all keyed alike; and extra-safe rolled edges on shelves and partitions.

This light-duty International helps take the tension out of high-tension work

Even when service work keeps your men working at top speed, you can count on light-duty International Trucks to lessen the strain.

You can count on the $11,000,000 valve-in-head Silver Diamond engine to deliver more power for faster trips to and from jobs. You can count on Super-steering and Super-maneuverability for new ease of handling, faster threading through traffic, and quicker turns in the shortest practical circles. Most important . . .

You can count on heavy-duty engineered stamina

Heavy-duty engineered stamina means day-in-and-day-out dependability, no matter how tough the going might be.

You get extra strength in every part of every light-duty International. This assures you the savings in operation and maintenance and the long life that have kept Internationals first in heavy-duty sales for 18 years.

And every service man can count on more comfort

A service man rides in an International Truck in almost as much comfort as he rides in a passenger car.

He sits in the Comfo-Vision Cab—"roomiest cab on the road." He gets full front visibility through a one-piece, curved Sweepsight windshield. He enjoys more positive steering control from a more comfortable position.

See your nearest International Truck Dealer or Branch

You serve your customers better with a truck that serves you better. It'll pay you to get all the facts now.

International Harvester Builds
McCormick Farm Equipment and Farmall Tractors . . . Motor Trucks
Industrial Power . . . Refrigerators and Freezers

Heavy-Duty Engineered

INTERNATIONAL TRUCKS

INTERNATIONAL HARVESTER COMPANY CHICAGO

Because you demand your switches **RUGGED**..

Above, type HPS, 3000 Ampere switch in open position—showing how outer pair of blades have progressed slightly beyond inner pair during sequence operation.

1 CONTACT—Hi-Pressure spot-cleans as it wipes as it closes. High conductivity to withstand short circuit stresses.

2 HINGE—Hi-Pressure, annular line contact—seals against dirt, always constant in any blade position. Uniform pressure washer maintains contact pressure with less critical adjustment than ordinary cup spring washer.

3 BLADE LATCH—Positive protection against short circuits. Combined lock and pryout operated with eye hook.

4 PRESSURE CLIPS—Phosphor Bronze individual spring clip for each Spot Contact on blade.

5 BLADE OPERATION—Sequence movement. Blades released from contact pressure in pairs to reduce operating effort.

The Check List

CONDUCTOR SUPPORTS, CLAMPS AND FITTINGS

DISCONNECTING SWITCHES
INDOOR AND OUTDOOR

HORN GAP SWITCHES

INTERRUPTER SWITCHES

CUTOUTS AND THERMO-RUPTERS

DISTRIBUTION EQUIPMENT

SWITCH OPERATING MECHANISMS

SUBSTATIONS

OPEN OR ENCLOSED, ISOLATED PHASE HEAVY DUTY BUSES

KIRK INTERLOCK SYSTEMS

AUTOMATIC SWITCHING EQUIPMENT

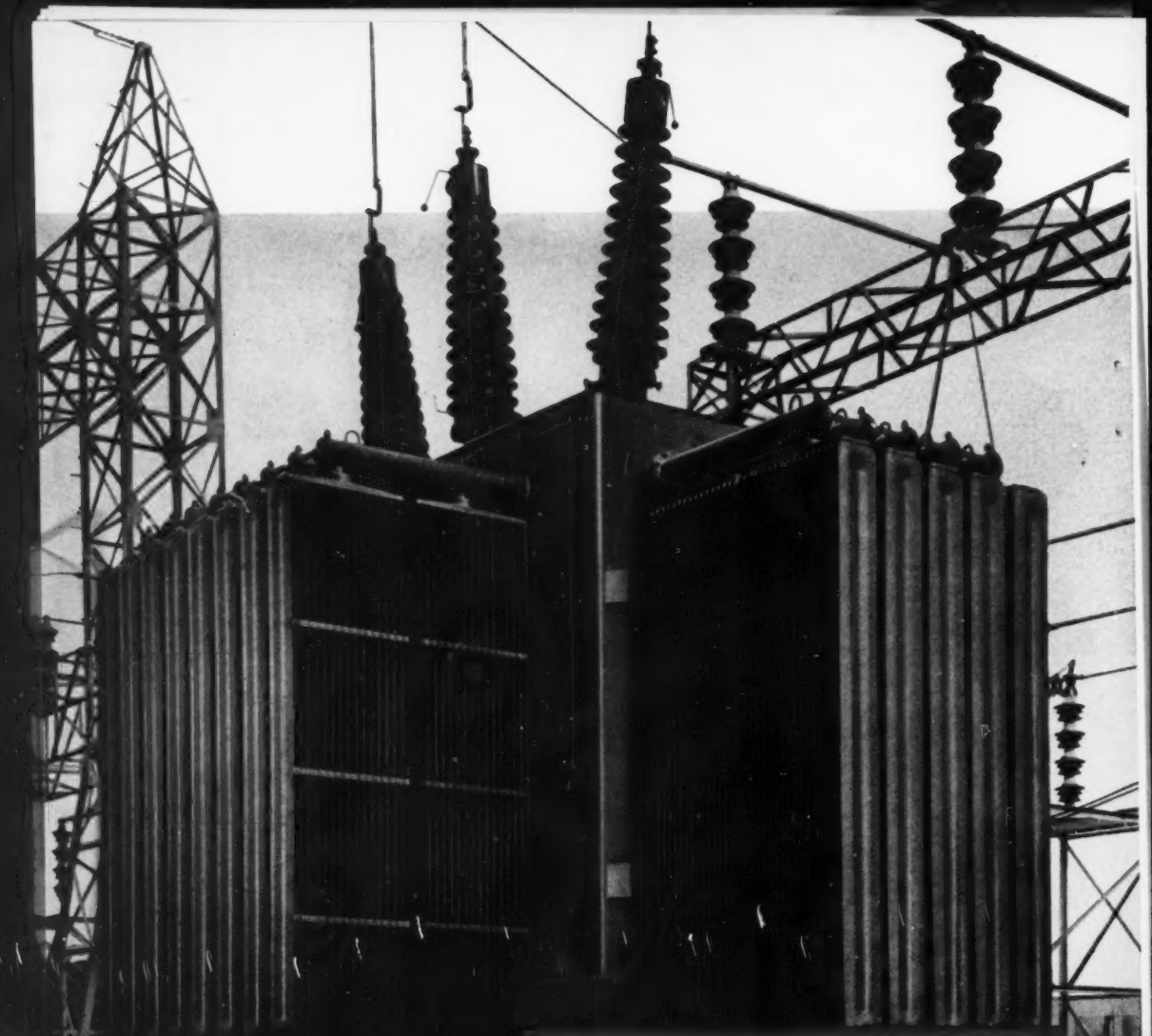
METAL CUBICLES

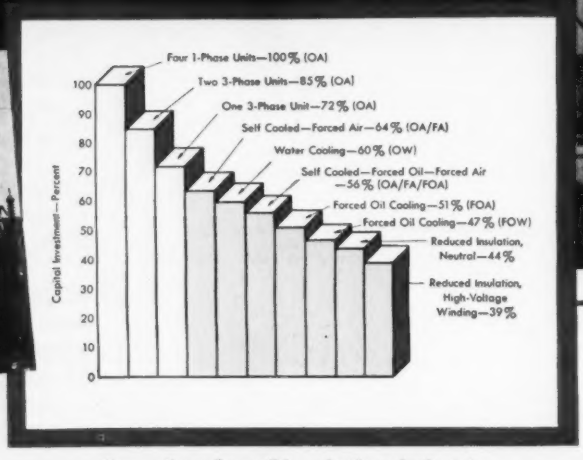
TESTING DEVICES

RAILWAY and INDUSTRIAL ENGINEERING CO., Greensburg, Pa.

IN CANADA—EASTERN POWER DEVICES LIMITED, TORONTO

AN I-T-E SUBSIDIARY





Summation of possible reductions in investment for generating station transformer banks.

MODERN 3-PHASE POWER TRANSFORMERS

Cut Capital Investment 15% to 28%

Important improvements in power transformer design and applications can bring savings that add up to 50%, and more.

For example, banks of single-phase transformers are being superseded by three-phase units, used singly and in pairs. In a typical instance, two three-phase transformers cut initial cost by 15% over a four-unit single-phase bank. Since reliability has been increased to a point where outages are practically negligible, a single large three-phase unit can be used, at an additional savings of 15%, or an over-all economy of 28% . . . and there's an appreciable improvement in transformer efficiency.

These examples are based on straight self-cooled design. By various applications of new cooling and insulating techniques, capital savings can be made to reach, or even exceed, 50%.

Westinghouse Power Transformers are smaller and lighter per kva than any other transformer on the market. As a result, you can expect these additional savings:

1. **Reduced space required.**
2. **Smaller foundations.**
3. **Smaller superstructures.**
4. **Lower field-assembly expense. Transformers shipped more completely assembled.**
5. **Lower maintenance expense...Rugged all-welded construction plus smaller size.**

Your Westinghouse representative will be glad to give you complete details. Phone him today, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-70580

WESTINGHOUSE POWER TRANSFORMERS ARE SMALLER AND LIGHTER PER KVA THAN ANY OTHER TRANSFORMER . . . YET THEY GIVE SUPERIOR PERFORMANCE

YOU CAN BE SURE.. IF IT'S

Westinghouse

POWER TRANSFORMERS

WESTINGHOUSE

That's the short way of saying MACALLEN mica — but in your specifications write it out in full so there won't be any mistake — and anything less than MACALLEN mica is a mistake.

when you think of MICA, think of MACALLEN

MACALLEN MICA

ALL FORMS, ALL QUANTITIES — ALL DEPENDABLE

THE MACALLEN COMPANY

16 MACALLEN STREET • BOSTON 27, MASS.

CHICAGO: 565 W. WASHINGTON BLVD. • CLEVELAND: 1231 SUPERIOR AVE.

Good Light

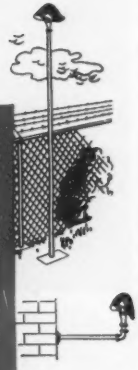
guards against intruders

The use of light to hold night-prowling marauders at bay dates back to man's earliest days. Appleton Floodlights give industrial plants and personnel this same time-tested protection in its most modern, most effective form. These big, rugged fixtures are expressly designed to guard industrial properties while providing the good light necessary for ideal working conditions.

For example, a series of Appleton Elipso Standlites—properly spaced along a fence-line or mounted on buildings—forms a veritable barrier of light. This is only one of the many expertly designed fixture models from the complete Appleton Floodlight line—a line that includes a sound, scientific answer to every known floodlighting problem.

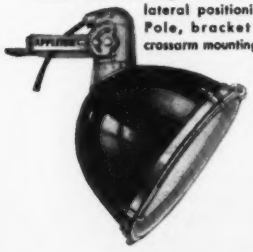
For fixtures that meet every industrial requirement—including hazardous locations—whether indoors or out, contact Appleton, pacesetting manufacturer of Electrical equipment for nearly half a century.

ELIPSO STANDLITE—Expertly designed to provide protection for industrial properties. Mounts on pole or wall.



APPLETON Floodlights

DIFFUSO FLOODLIGHT—For even illumination of service stations, athletic fields, parking lots, etc. Pole, bracket or crossarm mounting.



SPORTO—For high intensity illumination over large areas. Weatherproof hood allows for complete vertical or lateral positioning. Pole, bracket or crossarm mounting.

Sold Through Electrical Wholesalers

APPLETON ELECTRIC COMPANY

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Branch Offices: NEW YORK, 50 Church St.• DETROIT, 3049 E. Grand Blvd.• CLEVELAND, 1836 Euclid Ave.• SAN FRANCISCO, 655 Minna St. • ST. LOUIS, 227 Frisco Bldg. • LOS ANGELES, 100 N. Santa Fe Avenue • ATLANTA, 724 Boulevard, N.E. • BIRMINGHAM, 429 Brown-Marx Bldg. • MINNEAPOLIS, 305 Fifth St., S. • PITTSBURGH, 414 Bessemer Bldg. BALTIMORE, 100 East Pleasant, St. • BOSTON, 10 High Street • DENVER, 1921 Blake Street • PHILADELPHIA, 1017 Cherry Street • CINCINNATI, 626 Broadway • HOUSTON, 709 M. & M. Bldg. • HAVANA, Cuba, Malecon No. 9.

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A P P L E T O N

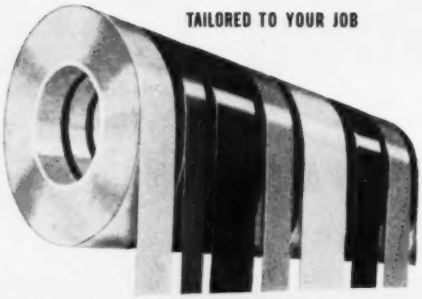
CONDUIT FITTINGS • LIGHTING EQUIPMENT • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES

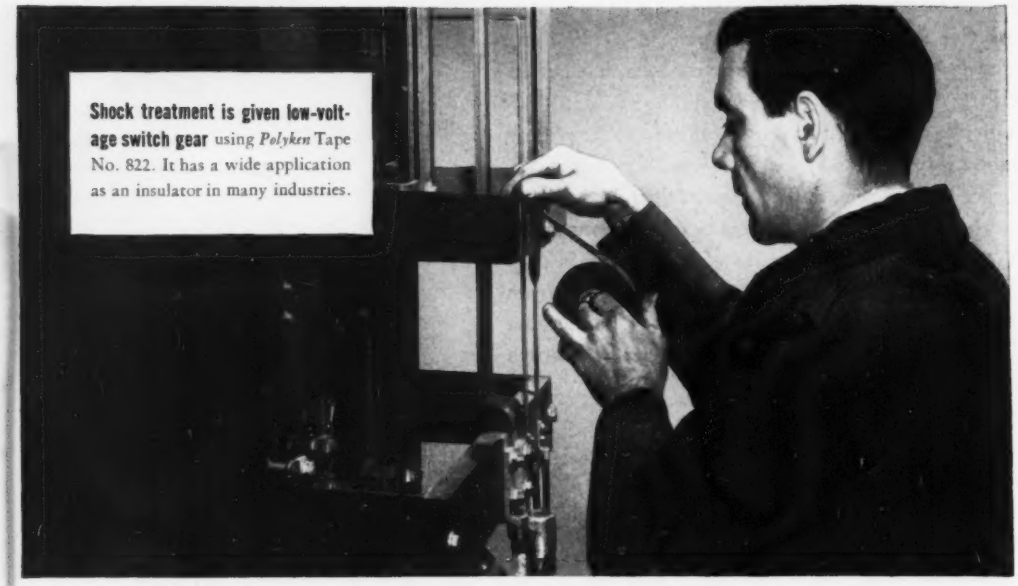
THE NEW

Polyken®

INDUSTRIAL TAPES

TAILORED TO YOUR JOB





Shock treatment is given low-voltage switch gear using *Polyken* Tape No. 822. It has a wide application as an insulator in many industries.

$$\frac{822}{10{,}000} = 0$$

This formula is a long way from scientific, but right on the button when translated. It means that *Polyken* Industrial Tape No. 822, over 10,000 volts, equals no shocks, no corrosion. Although the picture above shows a low-voltage application, No. 822 gives equally good high-voltage protection.

Polyken No. 822 is a polyethylene plastic-backed pressure sensitive tape. It is only 9 mils in thickness, yet with its polyethylene backing, has a dielectric strength of 10,000 volts, a power factor of .005 and insulation resistance of 106 megohms.

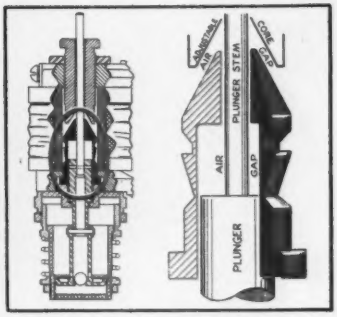
It has a moisture vapor transmission rate of 0.25 grams per 100 square inches for 24 hours at 80°C. This means that *Polyken* No. 822 provides excellent protection against corrosion of switch gear parts exposed to moisture or salt and chemical-laden air. Because of the elastic properties of polyethylene it will conform to odd-shaped surfaces.

A few seconds' thought will probably bring to mind some applications for this tape in your plant. Our engineers will be glad to discuss them with you . . . no obligation, of course.

FREE SAMPLES. Write today for complete engineering data, plus samples of *Polyken* No. 822. Address *Polyken*, Dept. EWC, 222 West Adams Street, Chicago 6, Illinois.

Polyken Industrial Tape, Department of Bauer & Black, Division of The Kendall Company

Complete
MOTOR PROTECTION
Under All Conditions
with these EC&M Overload Relays
Instantaneous Trip; also Time-Delay Operation
for Single Phase, Failure to Start,
Running, Etc. — all in this one Relay.



Special Iron Sleeve with tapered wall thickness provides magnetic balance, permitting *low* current setting.

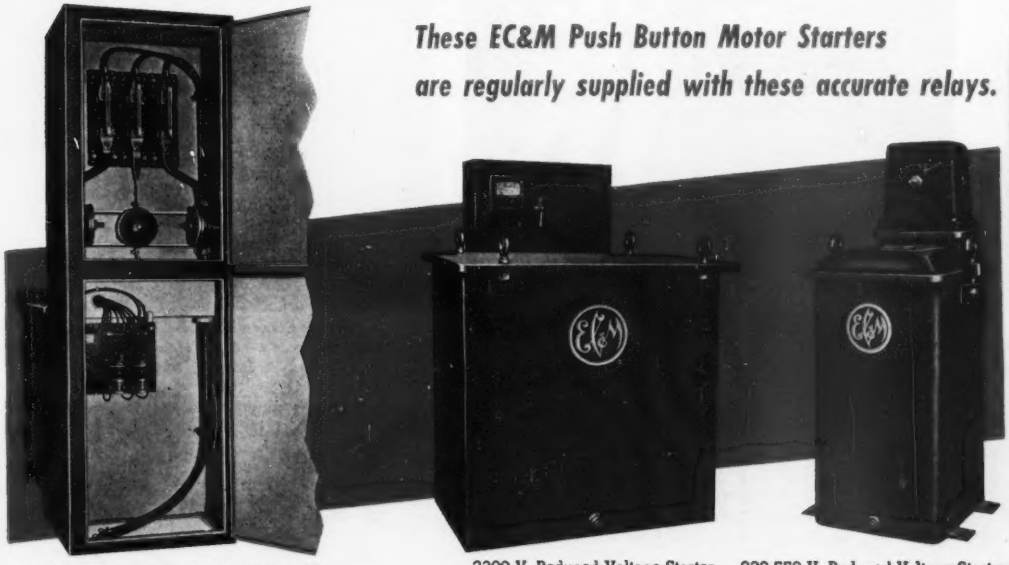
EC&M Type ZM Overload Relays for use in A-c Starters are of the magnetic type. They trip *instantly* on heavy overloads or short circuits and provide *inverse-time-element* trip on prolonged overloads or if the motor fails to start.

A *low* current-setting for accurate protection under running conditions is possible with these Relays because a magnetic-balance in each relay permits the absorption of the heavy inrush currents while the motor is accelerating. When the current is normal, the relay drops back automatically to keep timing at the maximum.

On short circuits the time-delay feature is by-passed. A spring on the outside of the dashpot-case normally holds the dashpot down, allowing the plunger to pull through the silicone fluid. When an excessive current occurs, the dashpot and plunger lift as a unit—the outer spring on the dashpot being compressed as the plunger *instantly* rises to trip the relay-contacts without delay.

Complete description of these Relays is given in Bulletin 1180-2 and No. 19 ACCELERATOR. Write for your copies.

These EC&M Push Button Motor Starters are regularly supplied with these accurate relays.



VALIMITOR Starters — 2300-4600 Volt Motors

2300 V. Reduced Voltage Starter

220-550 V. Reduced Voltage Starter

THE ELECTRIC CONTROLLER & MFG. CO.

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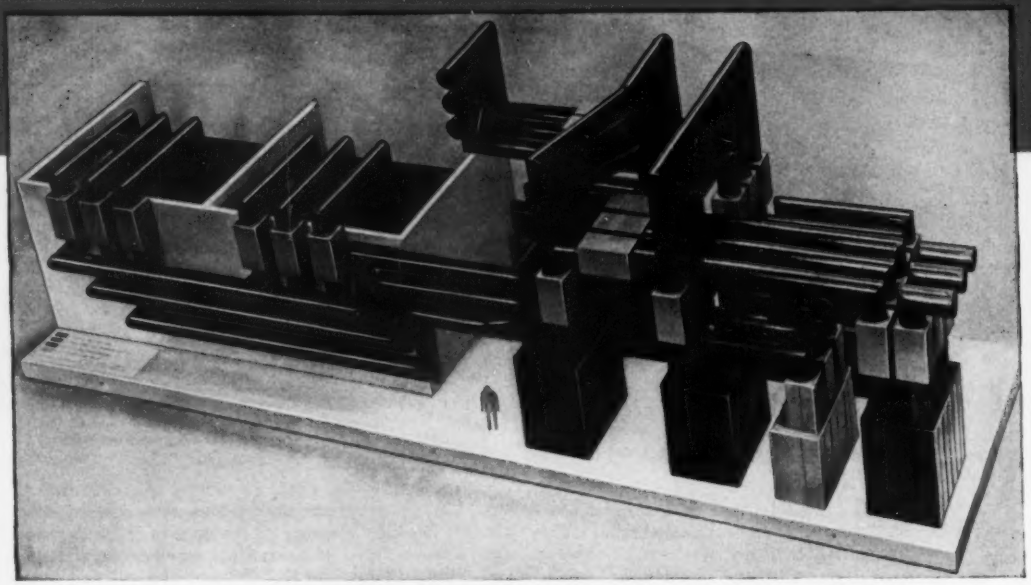
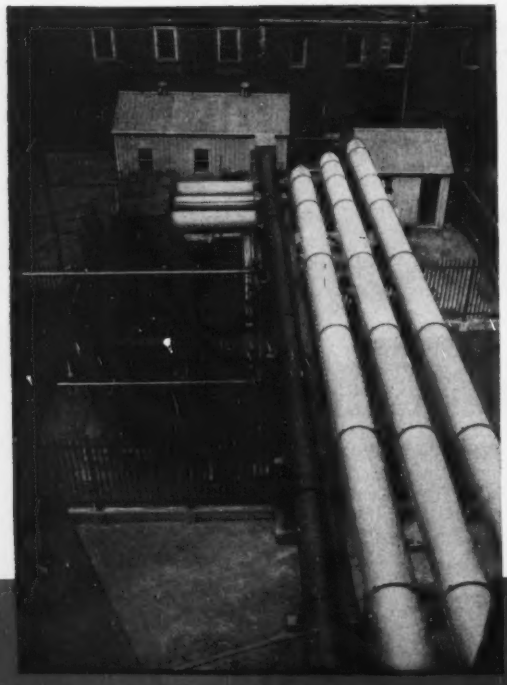
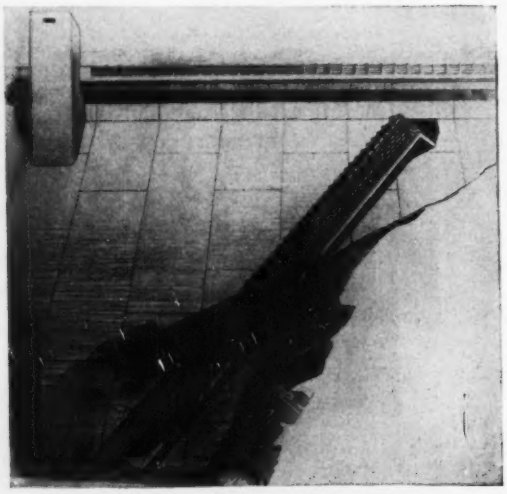


Scale Model 69 KV Distribution Bus — Consolidated Edison Company



4000 Ampere 15 KV Isolated Phase Bus
Delaware Station, Philadelphia Electric Company



Artist's Conception Grand Coulee Pump Bus
Each bus feeds 2—65,000 Horse Power Synchronous Pumping Motors

First in 1936 ... and still leading the way!

EXPERIENCE?

$17,100,000

24 MILES

AMPERE RATINGS	1200	to	7000 Amperes
VOLTAGE RATINGS	5000	to	69,000 Volts
INSTALLATIONS	72, over 100,000 KVA: Generators, Transformers, Distribution Buses, Main Buses		213

PLANT INVESTMENT

SINGLE PHASE FOOTAGE

Write for I-T-E Catalog 10147 for complete information on uses, construction and installation of I-T-E Isolated Phase Bus Structures, as well as convenient data and suggestions for planning a bus layout. Or ask your local I-T-E representative for information. He will be glad to help you.

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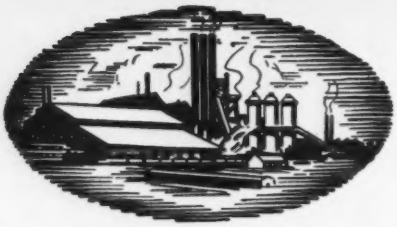
SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • CIRCUIT BREAKERS • MECHANICAL RECTIFIERS • RESISTORS • SPECIAL PRODUCTS



1900 ★ THE MIRACLE OF AMERICA ★ 1950

Freedom and Progress

It's no stretch of the imagination, rather, robust realism to call our past half century a Miracle—U. S. A.

America has set an amazing record of progress in 50 years—but a moment in the history of civilization. A record unequalled by any other political or economic system.

Merely by broad brush strokes, we can all visualize this miracle. Remember the crystal set, the hand-cranked car, the biplane? A far cry from our FM radio, television, hydro-matic drive and supersonic planes.

And here's another phase of the miracle that went hand-in-hand with these and the myriad of intertwined technological advances—ranging from the radio telephone and Bakelite to the X-ray tube and teletype . . . and to atomic energy and its untold potentialities.

- ★ Since 1900 we have increased our supply of machine power 4½ times.
- ★ Since 1900 we have more than doubled the output each of us produces for every hour we work.
- ★ Since 1900 we have increased our annual income from less than $2400 per household to about $4000 (in dollars of the same purchasing power), yet . . .
- ★ Since 1900 we have cut 18 hours from our average work week—equivalent to two present average workdays.

How did we do it? The basic cause for this composite miracle has been the release of human energy through FREEDOM, COMPETITION and OPPORTUNITY. And one of the most important results is the fact that more people are able to enjoy the products of this free energy than in any other system the world has ever known.

THIS IS THE MIRACLE OF AMERICA . . . it's only beginning to unfold.

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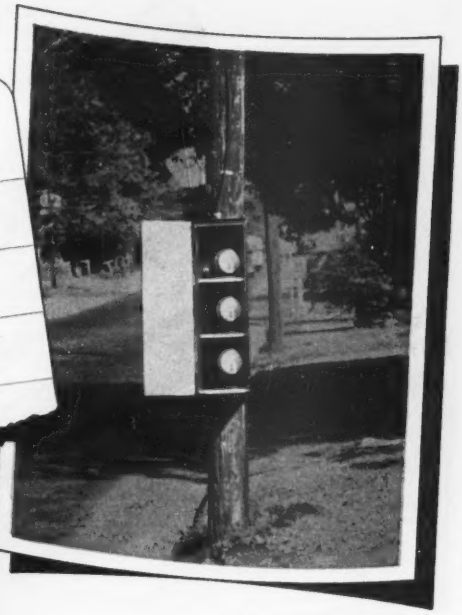
Here's How

You can get more watts out of your copper—



This Photo Courtesy of Gulf States Utilities Company, Baton Rouge, La.

LINCOLN MINIMAX INDICATING VOLTMETERS

...the *Low Cost* way to obtain continuous voltage information

MiniMax Voltmeters can be installed in standard meter sockets.

To get the most out of your copper, correct voltage levels must be maintained on the basis of *continuous information*. This information can be obtained through the use of indicating voltmeters mounted at load centers along your system.

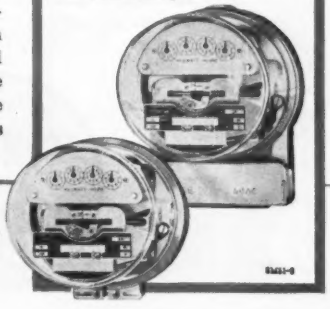
Lincoln MiniMax Indicating Voltmeters provide the most economical way to get the information you need for setting voltage regulators and for solving other voltage control problems. They make the use of graphic meters unnecessary in most cases, and permit inexpensive, *permanent* installations that save the valuable man hours required to make periodic surveys.

The MiniMax voltmeter is equipped with a minimum and a maximum voltage indicator on either side of a pusher pointer which is fixed to the actuating element of the meter. The pointer spreads the indicators apart with changes in voltage. These indicators show the 10-minute averages of minimum and maximum voltages which have occurred since the last resetting. The pointer shows the average voltage at any time. The MiniMax is time lagged so that instantaneous values are not shown.

Bulletin 483 gives full information . . . write for your copy today.

Sangamo J Meters

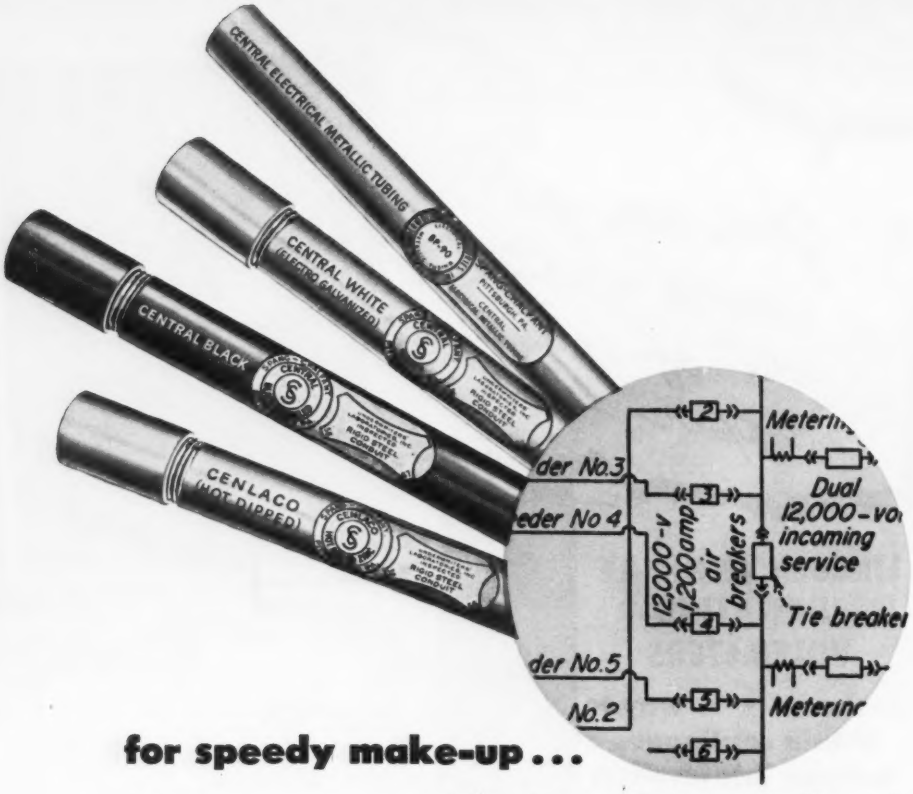
These watthour meters meet today's requirements and tomorrow's anticipated loads with sustained accuracy, economy of maintenance and troublefree performance.



Only Measured Facts are Known Facts

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS



for speedy make-up . . .

choose your conduit from Central's Big 4

Wiring jobs go together fast when the conduit is Central. Uniform quality from bundle to bundle assures uniform, predictable cutting, bending, and fitting-up.

For any wiring job, choose the most suitable, most economical conduit from Central's big 4 . . . "Cenlaco" with hot-dipped galvanized finish inside and out, "Central White" with electrogalvanized zinc outside and black enamel inside, "Central Black" with durable black enamel inside and out, or "Central EMT", a sturdy, lightweight steel conduit that's electrogalvanized outside, black enameled inside.

All Central Conduit is approved by Underwriters' Laboratories and the National Electrical Code. It is easy to cut, bend, and run, easy to fish through . . . and is the result of Spang's 111 years of tubular manufacturing experience.

Your supply house may have difficulty meeting the huge demand for Central Conduit . . . but they are earnestly trying to fill orders fairly, and as quickly as possible.

CENTRAL SPANG CONDUIT

SPANG-CHALFANT

Division of The National Supply Company
GENERAL SALES OFFICE: Grant Bldg., Pittsburgh, Pa.
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The design of Penn-Union Multifit Connectors retains the full strength and rigidity of the Everdur bolt. The saddle which provides a wide surface to grip and protect the cable is permanently fastened to the U-bolt; one piece. The strongest and most satisfactory fitting of this type. High copper content alloy; Everdur Nuts and Lockwashers as well as Bolts.

★ Each Multifit Connector takes a wide range of conductor sizes; only a small stock will provide for many needs. Made in a complete range for cable up to 2,000,000 cm.

The Penn-Union line also includes numerous other types of Tees, Lugs and Straight Connectors, as well as Service Connectors, Bus Supports, Grounding Clamps, Cable Taps, etc., etc. Experienced users have found that the Penn-Union mark on a fitting is their best guarantee of satisfactory performance.

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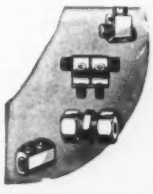
PENN-UNION ELECTRIC CORPORATION

Erie, Pa.

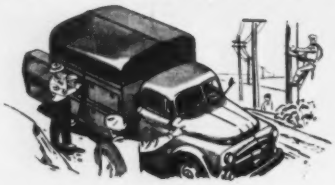
Canada: Dominion Cutout Co., Ltd., 250 Richmond St. West., Toronto, Ontario

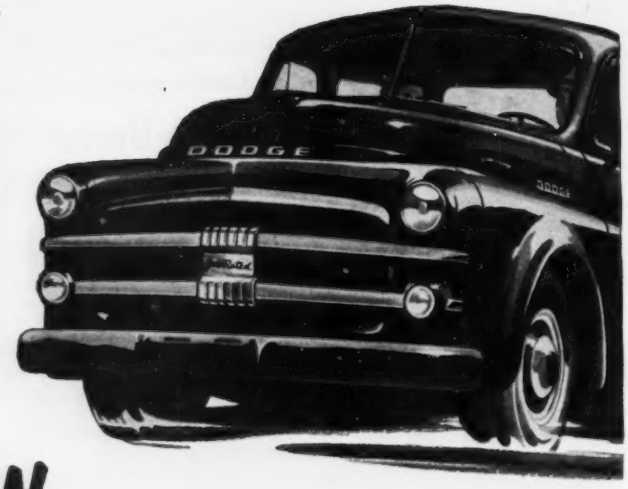
THE *Complete* LINE OF CONDUCTOR FITTINGS



PENN-UNION

"Job-Rated" for UTILITIES





Brand new DODGE "Job-Rated" TRUCKS

The trucks that do the most for you!

More than 50 BRAND-NEW improvements . . . including

NEW! SMOOTHER RIDE with new, "Oriflow" shock absorbers—standard equipment on ½-, ¾-, and 1-ton models.

NEW! EASIER LOADING with lower ground-to-floor height—on all models through 2 tons.

NEW! EASIER BAD-WEATHER STARTING with new moistureproof ignition and high-torque starting motor.

NEW! MORE ECONOMICAL PERFORMANCE with higher (7.0 to 1) compression ratio—on all models through 1 ton.

NEW! SMOOTHER ENGINE IDLING with "hotter" spark plugs; on all models through 1 ton.

BRAND-NEW POWER—You get more power than ever—engineered for *your* job! Eight great engines—with net horsepower stepped up as much as 20%! You get more of the *right* power for your needs—with top economy! Yet, with all their extra value, new Dodge *"Job-Rated"* trucks are priced with the lowest.

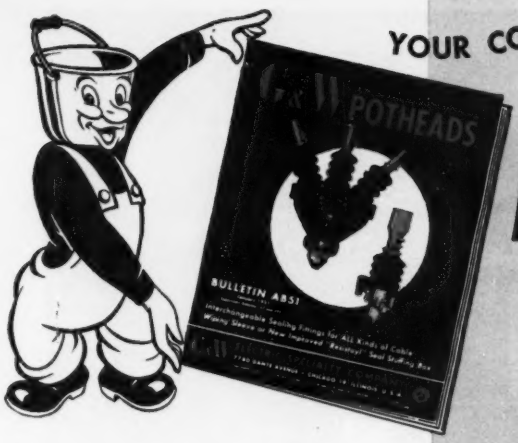
BRAND-NEW EASE-OF-HANDLING—You can turn new Dodge *"Job-Rated"* trucks sharper . . . maneuver them more easily. New shorter turning diameters! New worm-and-roller steering gears! All this—plus cross-steering, wide front tread and short wheelbase.

BRAND-NEW BRAKING SAFETY—New Dodge *"Job-Rated"* trucks are the trucks with new molded, tapered Cyclebond brake linings! New *extra-quiet* action! New extra-smooth, extra-sure stopping! New longer lining life! (On new 1½-ton and up trucks, except air brake models.)

PLUS THIS EXCLUSIVE! gyrol Fluid Drive available on ½-, ¾-, and 1-ton, and Route-Van trucks.

See your Dodge Dealer today for

THE TRUCK THAT FITS YOUR JOB... A DODGE "Job-Rated" TRUCK



YOUR COMPLETE NEW CATALOG OF

G&W POTHEADS

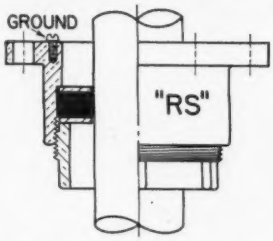
Complete listings make this bulletin a must for your desk. Keep it handy for easy reference to all ratings and shapes of G&W Potheads and related information.

- Capnut Terminal Potheads
- Disconnecting Potheads
- Straight Through Potheads
- Equipment Type Potheads
- New Shape "CL" 45° Angle Bodies
- New Shape "A" Pole-Top Potheads
- Special Listings of All Parts
- Spreader Heads
- Insulating Compound
- Installation Instructions
- New Universal Cable Entrance

LISTING FOR THE FIRST TIME

NEW *UNIVERSAL* ENTRANCE

FOR ALL TYPES OF CABLE



TYPE "RS" RESISTOYL ENTRANCE SEAL

Stuffing box with "Resistoyl" gaskets makes water, oil, and compound-tight seal on any cable sheath. Easily installed fittings furnished for conduit, armor, and wire armor.

SEND FOR YOUR COPY TODAY!

If you are now receiving regular G & W mailings, you will automatically receive your copy of this new bulletin soon.

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☐ *Check here if you would also like a copy of Bulletin AA50, Type "ST-SODERTITE" potheads with metal parts soldered directly to porcelain.*

For

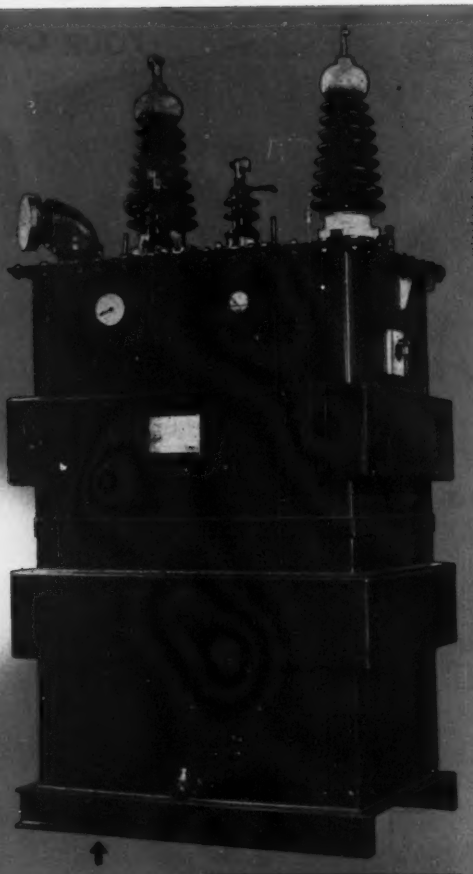
High Voltage Circuits

Uptegraff DISTRIBUTION TRANSFORMERS

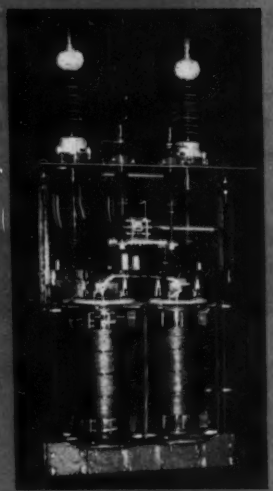
Built for operation up to 115,000 volts, Uptegraff High-Voltage Distribution Transformers are designed to meet all conditions encountered in this service. Insulation design is fully coordinated for all recognized operating conditions. In these designs, the same even distribution of potentials has been achieved as in lower voltage transformers, by avoiding corona and points of high dielectric stress. Long life and continuous service are provided for by the elimination of insulation "hot spots."

Uptegraff High Voltage Transformers are vacuum-filled, to prevent air inclusions. They conform with NEMA and ASSA standards.

Prompt deliveries can be arranged.



333 KVA Uptegraff Distribution Transformer, oil-immersed, self-cooled, 66000—7200/12470 Y volts.



Core and Coil assembly, as seen from the low voltage side.

Uptegraff TRANSFORMERS

POWER · DISTRIBUTION · INSTRUMENT SPECIALTY

R. E. UPTEGRAFF MANUFACTURING CO.

SCOTTDALE, PENNA.

HOW LONG

EVER since 1935 when the first Simplex-ANHYDREX rubber-jacketed cables were put on the market, they have shown themselves to be remarkably free from trouble. Not once in all that time has an ANHYDREX Cable failed because of water absorption. That's why we can't give an adequate idea of the length of service you can expect from ANHYDREX Cable.

But accelerated aging tests constantly carried on by the Simplex Laboratories give us good reason to predict that their service life will be long and trouble-free.

Tests for mechanical water absorption prove that during seven days' immersion at 158°F. (70°C.) Anhydrex SA insulation absolutely will not absorb more than 20 mg. of water per square inch of exposed surface.

Tests for electrical stability in water show that after one day's immersion at 158°F. (70°C.) Anhydrex SA has a dielectric constant that will not exceed 3.2. The increase in capacitance between one and eight days' immersion at 158°F. (70°C.) will not exceed 3.5% for insulation thicknesses greater than 4/64" or 5% for thicknesses of 4/64" and less.

Physically too, ANHYDREX Cables are tops. Their tough neoprene jacket stands up under year-in, year-out exposure to soil acids and alkalies and is fully able to withstand all manner of rough handling. If you run your cables up above ground you'll find it provides protection against weather hazards, sunlight, and swaying tree branches.

Performances in the field back up the story our lab tests tell. Why not discover, yourself, just what these figures can mean? . . They're easily translated into added years of service per cable plus worthwhile savings for you.

SIMPLEX-ANHYDREX

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.

This Firefighter can be two places at once!

You can protect several danger spots at one time with a Kidde built-in carbon dioxide fire extinguishing system. ¶ Widely separated fire hazards... even on different floors can be protected by a single Kidde system. If fire strikes a protected space, directional valves rush fire-smothering carbon dioxide gas to the stricken area. The same CO_2 can set off mechanisms to shut doors and windows... turn off fans and machinery. After doing its job, the clean, dry CO_2 evaporates completely. ¶ Whatever your fire detection and protection problem may be, a Kidde expert will be glad to help. When you think of CO_2 call Kidde.

Walter Kidde & Company, Inc., 330 Main St., Belleville 9, N. J.
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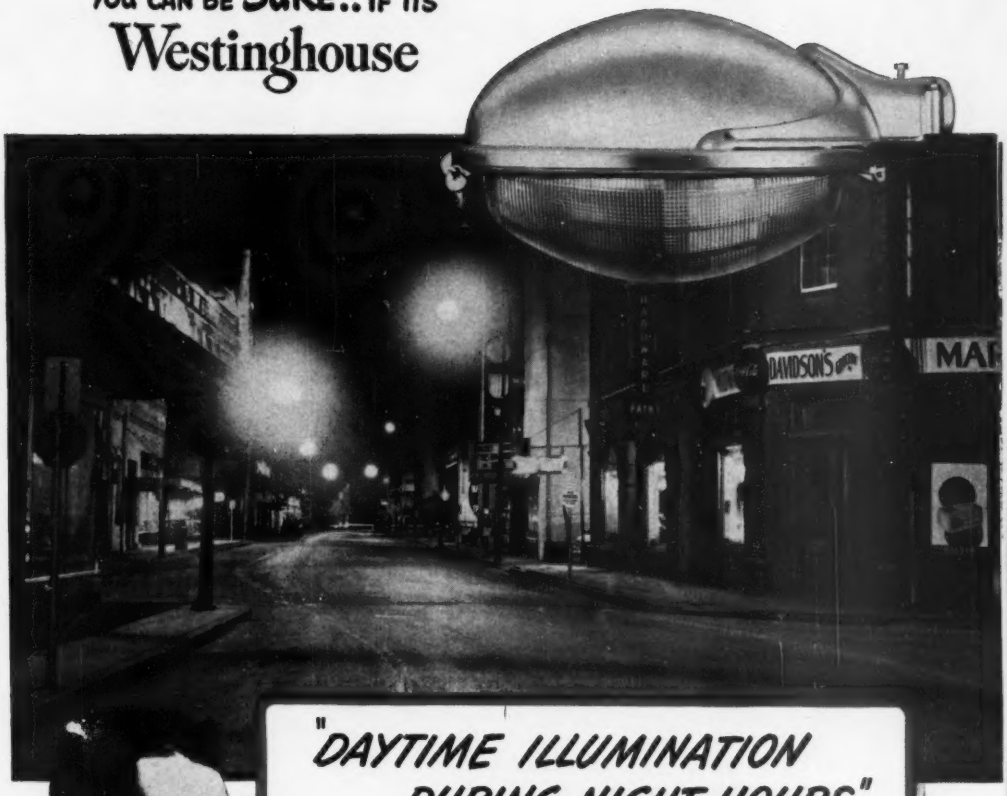
Kidde

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



"DAYTIME ILLUMINATION DURING NIGHT HOURS"

"When the City of Houma considered the illumination of its main thoroughfare, it selected the OV-20... Now that our project is completed, our citizens are proud of the daytime neatness of our Main Street with the 'daytime' illumination during the night hours", writes Mayor Leon Gary of Houma, Louisiana.

He points out results by further stating, *"Our merchants are capitalizing on the fine details obtainable in window displays under the Mercury Vapor Lighting system"*.

Not only business results, but added protection, he states, *"Our Police Department is enjoying an easier task from the bright illumination of our high value mercantile area"*.

To sum it all up, *"Frankly, it has been the most popularly accepted of the many projects of our administration"*.

This is only one of hundreds of case histories proving the economy of Westinghouse street lighting. A story Westinghouse is telling your customers, the readers of municipal papers.

If you want reprints or other material to promote better seeing in your towns, write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-04278

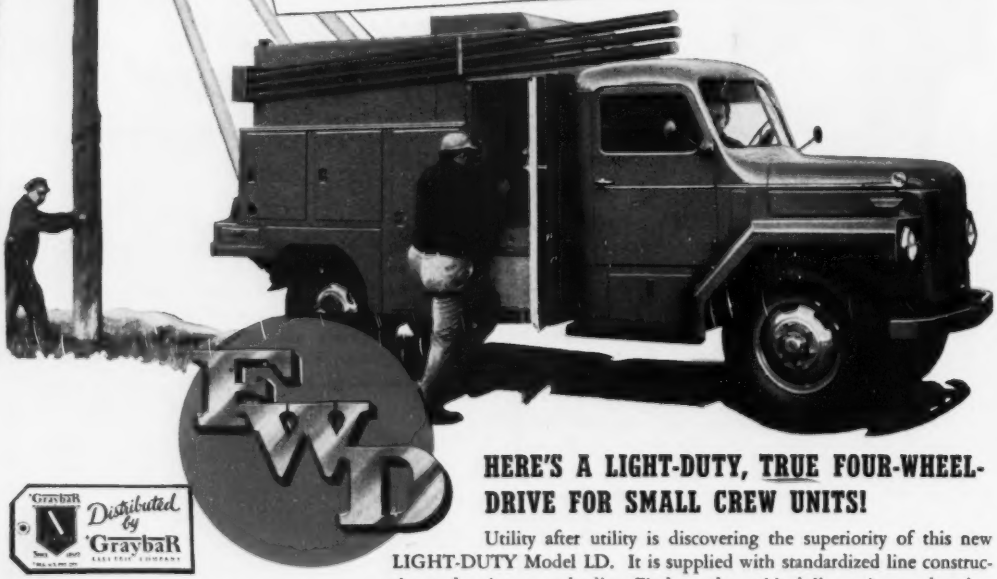
Westinghouse
PLANNED LIGHTING SYSTEMS

You Choose More than a Truck when you Choose an FWD

YOU CAN RESTORE SERVICE FASTER . . . MEET CONSTRUCTION SCHEDULES. "Weather and terrain are no problem. FWDs go where other trucks won't . . . *work* when others can't. Teamwork is tops because we have *matched combinations* of truck and equipment to fit the job."

YOU GET LOWER MAINTENANCE AND LONGER TRUCK LIFE

"FWD's proper distribution of load and power means less strain. Less strain means longer wear—fewer repairs. FWDs give us up to twice the life of ordinary trucks."



Distributed by GraybaR

Write Graybar or FWD for facts on the new LD plus data on over 40 different FWD line construction and maintenance units.

HERE'S A LIGHT-DUTY, TRUE FOUR-WHEEL-DRIVE FOR SMALL CREW UNITS!

Utility after utility is discovering the superiority of this new LIGHT-DUTY Model LD. It is supplied with standardized line construction and maintenance bodies. Find out about this dollar-saving truck today. THE FOUR WHEEL DRIVE AUTO CO., Clintonville, Wisconsin, Canadian factory—Kitchener, Ont. *World-Wide Sales and Service.*

Built by the Makers of America's Foremost Heavy-Duty Truck

KEARNEY Fuse Links

HAVE BECOME

the Industry's Preference..

because they are . . .

More Accurate for True Fusing

Have Truer Operating Characteristics

Designed in Four Speeds for Every Application

and Are Packaged in Color Identifying Cartons

JAMES R. KEARNEY CORPORATION
4224-42 Clayton Ave., St. Louis 10, Missouri
Canadian Plant: Guelph, Ontario

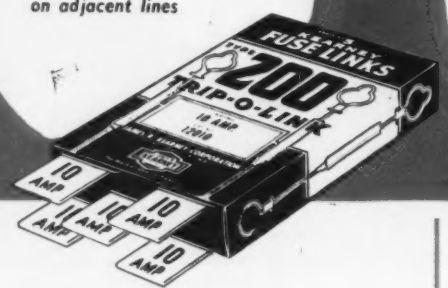
See following pages for more specific information about these popular Fuse Links.

Here They Are—

for EVERY APPLICATION...
COLOR IDENTIFIED to ELIMINATE
FUSE LINK CONFUSION

TYPE 200

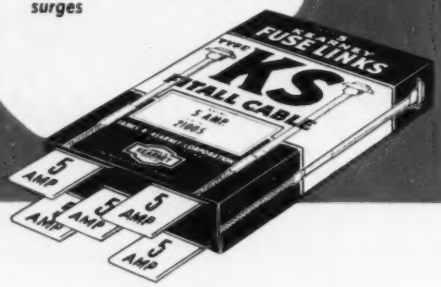
For prompt isolation of troublesome circuits— while maintaining service on adjacent lines



Certain circuits may prove to be more troublesome than others. When a line is subject to damaging long-time overloads and surges, continuity of service in adjacent circuits demands prompt action in isolating the troublesome line. This reliable protection is made possible by the accurate, durable characteristics of the pure tin used in the Type 200 Fuse Link. The low temperature operation of this link assures that overloads up to 150% of the fuse rating can be carried for one hour without damage to the fuse or fuse cutout.

TYPE KS

For reducing outages on circuits subject to switching and lightning surges



Where switching, motor-starting and lightning surges are common, maintain service by using the Type KS Fuse Link. Low temperature operation accommodates peak loads and dragging overloads with full protection to line equipment and without damage to the cutout. The overload capacities of the Type KS and Type 200 links are identical; however, the surge capacity of the Type KS fuse is twice that of the Type 200. In a thorough coordination plan, fuse links must coordinate not only with other fuses, but also with circuit breakers, and the slow speed characteristic of the KS link provides for the proper teamwork.

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

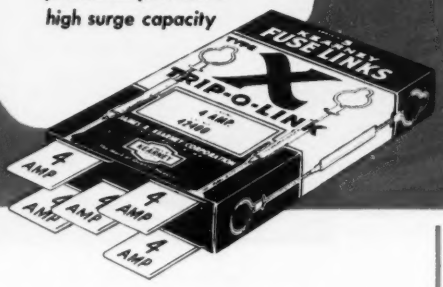
JAMES R. KEARNEY CORPORATION 4224-42 Clayton Ave., St. Louis 10, Mo.
Canadian Plant: Guelph, Ontario

SPECIFY KEARNEY PRODUCTS...

KEARNEY Fuse Links

TYPE X

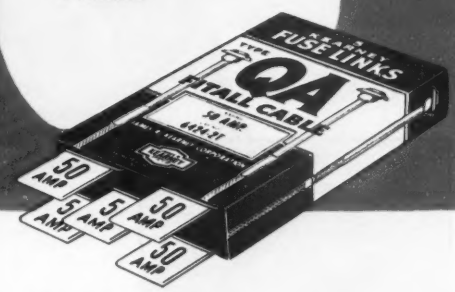
For distribution transformer overload protection plus extra high surge capacity



Designed to match the safe-loading curves of distribution transformers, the Type X Fuse Link keeps transformers in service during heavy overload periods and surges, and yet fuses in an instant when faults persist or reach damaging ranges. The extra high surge capacity means satisfied customers and lowered expense due to unnecessary outages. High tensile strength of Type X fuses prevents mechanical failure due to handling . . . a feature particularly important in fractional-ampere ratings. The Type X fuse is designed to carry full rated load continuously and to open 230% of rated current within 5 minutes.

TYPE QA

Designed to open 150% of rated load within 5 minutes



The QA link is designed to open at a lower percentage of rated current and therefore will fuse more rapidly than fuse links of the same ampere rating which have been designed to open 230% of rated load within 5 minutes. For working out coordination problems involving *all* Kearney Fuse Links, minimum melting and total clearing time-current curves on NEMA standard forms, together with fuse coordination charts, will be supplied upon request.

Keep the Right Link in the Right Place at the Right Time with a Kearney pole-mounted Fuse Link Dispenser.

-172

Better Construction – *SAFER* Maintenance

IT'S "LOADED" WITH BETTER TELEPHONE SERVICE

Twenty of the Bell System's newest small loading coils—like the one at the left—are housed in the long black case, mounted in a cable splice. This type of installation permits the economical extension of city cables to serve out-of-town subscribers.

MANY more wires can be crowded into a cable sheath when the wires are fine. But normally, wires don't transmit as well when they are fine and closely packed.

Bell engineers long ago learned to make wires do better work by loading them with inductance coils at regular intervals. The coils improve transmission and let messages travel farther. But originally the coils themselves were large, heavy and expensive. The cases to hold them were cumbersome and costly too.

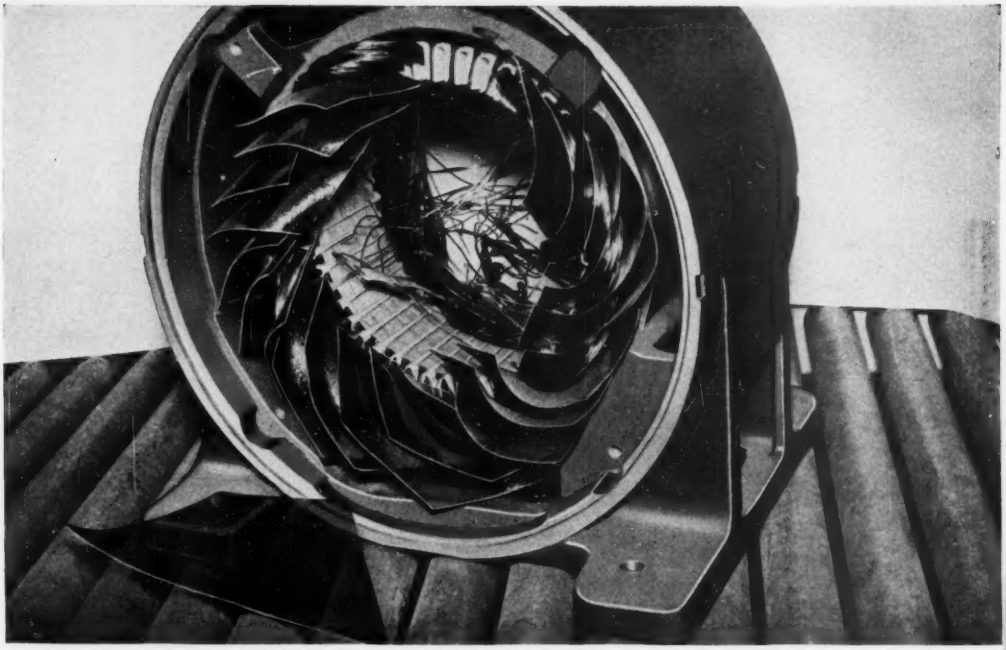
So year after year Bell scientists squeezed the size out of coils. To make magnetic cores of high permeability they developed Permalloy. Tough but extra-thin insulation permitted more turns to a core.

New winding machines were developed by the Western Electric Company. Coil size shrunk to one-fiftieth. Some—like the one shown above—can be mounted right in cables themselves.

The 15,000,000 coils in the Bell System today mean thinner wires, more wires in a cable—more economical service for you. They demonstrate once more how Bell Telephone Laboratories work continually to add to your telephone's value.

BELL TELEPHONE LABORATORIES

WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE BIG IN VALUE AND LOW IN COST



When insulation must stand 500° Heat ...look to IRVINGTON'S Class "H" Line

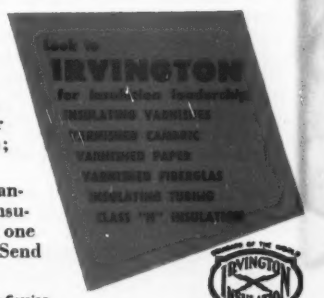
Whether you are winding for service at high ambient temperatures — for increased *continuous* power ratings — for greater *short-time* overload capacity . . .

Or *designing* for space-and-weight savings . . .

You will find the Class "H" insulation you want in the complete Irvington line.

Depending on service requirements, *your* high-temperature insulation job may call for Silicone Varnished Fiberglas*, in yard goods, tape or tubing forms; Silicone Glass Mica; Silicone Saturated or Silicone Coated Asbestos; Silicone Rubber Coated Fiberglas; Silastic**Tape, Teflon Coated Fiberglas.

We make them *all* — we're ready to help you use *each* to best advantage. Write for a free copy of our book — Irvington Class "H" Insulations — it contains samples. Perhaps you'd prefer to talk with one of our engineers. The coupon below is for your convenience. Send it today. No obligation.



*Owens-Corning Fiberglas Corp. **Dow Corning

Send this convenient coupon now

Irvington

VARNISH & INSULATOR COMPANY

6 Argyle Terrace, Irvington 11, New Jersey

Irvington Varnish & Insulator Co. EWO-3/51
6C Argyle Terrace, Irvington 11, N. J.

☐ Please send me a free copy of "Irvington Class 'H' Insulations".

☐ I'd like to see one of your engineers. Please have him phone or write for an appointment.

Name ..... Title .....

Company .....

Address ..... Phone .....

City ..... State .....

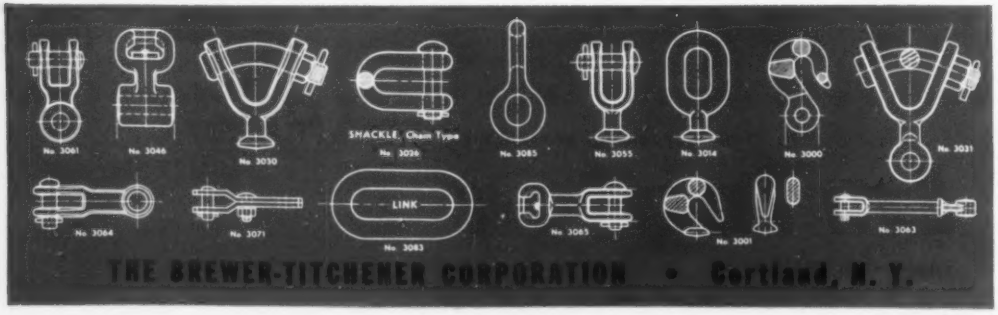
STANDARD *Drop Forged* STEEL FITTINGS

Aside from Conductor and Ground Wire Clamps and Strain Yoke Sets, a *complete line* of transmission hardware *must* include a considerable number of standard, quickly-available accessory fittings, designed for all classes of service, for use with ball socket or clevis type insulators in all standard M & E Strength Ratings. Some fittings are used in large quantities—others in small lots. Invariably some of each class are needed to fill any transmission line bill of materials.

Over 100 catalogued Drop Forged Steel Fittings comprise the BTC *complete line.* Many of the items are furnished in various eye widths, hole sizes, connecting lengths and strength ratings. Numerous other special purpose fittings—for which dies and tools are available—can be supplied on special order.

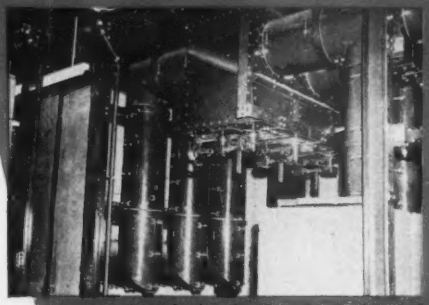
Specify BTC Fittings with BTC Clamps and Strain Yoke Sets to insure careful design, trouble-free installation and long service life.

Sold through your insulator manufacturer only.



R&IE

ISOLATED PHASE HEAVY DUTY BUSES FOR Consolidated Edison ARE INSULATED WITH NATVAR VARNISHED BIAS TAPE



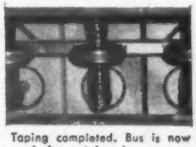
A completed portion of power generated bus and switches shows how neat and compact the 3500 Ampere Isolated Phase Bus installation is at Consolidated Edison's Waterside No. 1 station.

Insulator ring support section and 3500 Ampere conductor taped with Natvar V C tape as in the Isolated Phase Bus installation in Consolidated Edison's Waterside No. 2 station. Insulators are always under compression.

Progressive views of procedure in taping a 2000 Ampere conductor for switch terminal and expansion joint in Consolidated Edison's Jamaica station:

Partly taped section of conductor held by insulator ring support.

Taping shield installed over flexible connection, ready for final taping.



Taping completed. Bus is now ready for metal enclosure.

Metal Enclosed Isolated Phase Bus structures built for Consolidated Edison Co. by Railway and Industrial Engineering Co., Greensburg, Pa., for high voltage, high capacity, call for high reliability in service, a minimum of maintenance and a compact yet flexible arrangement. Each system is designed for its specific installation, and completely fabricated at the factory for final assembly on the job.

Component parts and materials must be of top quality. Conductors are taped with Natvar varnished bias tape because of its uniformly good electrical and physical properties.

Natvar flexible insulation is available either from your wholesaler's stocks or direct from our own.

Natvar Products

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Silicone coated Fiberglas
- Varnished papers
- Slot insulation
- Varnished tubings and sleevings
- Varnished identification markers
- Lacquered tubings and sleevings
- Extruded vinyl tubing and tape
- Extruded vinyl identification markers

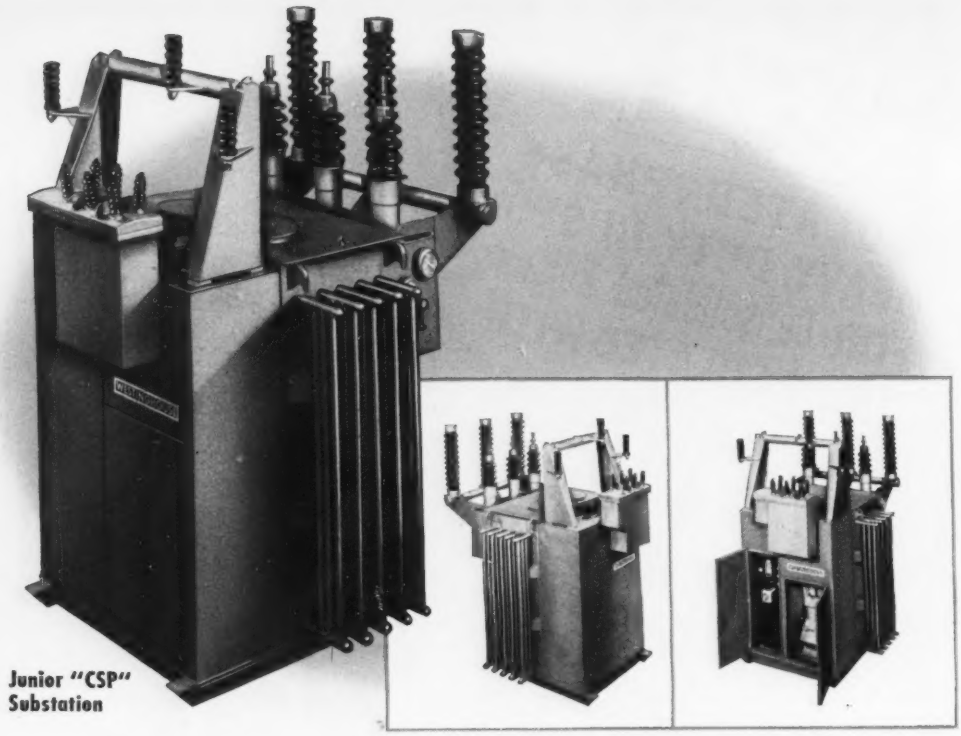
Ask for Catalog No. 21

THE NATIONAL VARNISHED PRODUCTS Corporation

Telephone Rahway 7-8800

Cable Address NATVAR: Rahway, N. J.

221 RANDOLPH AVENUE ★ WOODBRIDGE, NEW JERSEY



Junior "CSP" Substation

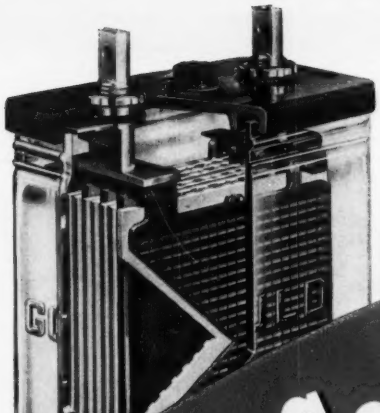
Greater Flexibility...Simplified Maintenance for SMALL CAPACITY FEEDERS

It's easy to move . . . easy to tie in. That's the new Junior "CSP" Substation, designed to give the flexibility needed for changing and growing loads. Completely enclosed construction gives all-weather protection. All parts are easily accessible . . . maintenance can be handled quickly and easily at ground level. In fact, the Junior "CSP" Substation gives every advantage of unit equipment . . . for *small* substation use.

The Junior "CSP" Substation is ideal for small towns . . . rural lines . . . and industrial plants where capacity of feeder does not justify a higher rating. It's a new design based on principles proved through years of dependable service with large "CSP" Substations. The Junior "CSP" (Completely Self-Protecting) Substation has both thermal and lightning protection built in. And it's completely factory-assembled with integral high and low-voltage switchgear, and metering equipment.

Available in ratings from 300 to 1,000 kva; others to 3,000 kva. For more information call your nearest Westinghouse representative, or write for Booklet B-4692, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-70584

YOU CAN BE SURE.. IF IT'S
Westinghouse
JUNIOR "CSP"
POWER TRANSFORMER



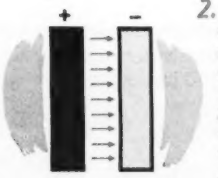
Choose Gould Planté

The Battery that Lasts Practically Forever!

1. *Batteries on full float service require a small current to offset normal self-discharge. This self-discharge is due primarily to migration of antimonial impurities from the positive grids or grid frames to the negative plates.*

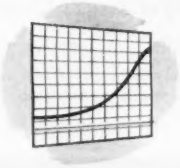
Gould Planté Batteries stay in active service for 20 years, 30 years and even longer—because all of each positive plate is pure lead. They float at constant voltage, maintain rated capacity all their life . . . and almost never need service. Choose

GOULD PLANTÉ
The Aristocrat of Stationary Batteries



2. *In ordinary batteries as the self-discharge rate increases, more and more antimony is transferred to the negative plates. The cycle is repeated with increasing tempo until the positive grid fails completely.*

3. *Gould Planté Batteries contain no antimonial impurities. Therefore, their voltage requirements and capacity remain constant throughout their amazingly long, low-cost life.*



GOULD
STORAGE BATTERIES
GOULD-NATIONAL BATTERIES, INC.*
TRENTON 7, NEW JERSEY
Always Use Gould-National Automobile and Truck Batteries
*Formerly Gould Storage Battery Corporation

Why gamble on a "PIG IN A POKE?"

you know Exactly how every FLEUR·O·LIER luminaire will perform

There's no guessing about how a Fleur-O-Lier lighting installation will perform. You know in advance the tested, certified illuminating performance.

This certainty of results is possible because for every Fleur-O-Lier fixture there is available complete, authoritative performance data. Thus, you get the precise lighting results specified by the architect, contractor or lighting advisor.

Fleur-O-Lier gives you these advantages:

1. The Fleur-O-Lier Index System Rating, assigned by Electrical Testing Laboratories, Inc., after careful test, tells exactly what the illuminating characteristics of the luminaire are.

2. Complete photometric data is compiled by ETL.

3. Coefficients of utilization are computed by ETL. This data is essential in selecting the most suitable fixtures for the installation.

4. Certification by ETL assures the fixture was made to the rigid specifications covering electrical and mechanical features.

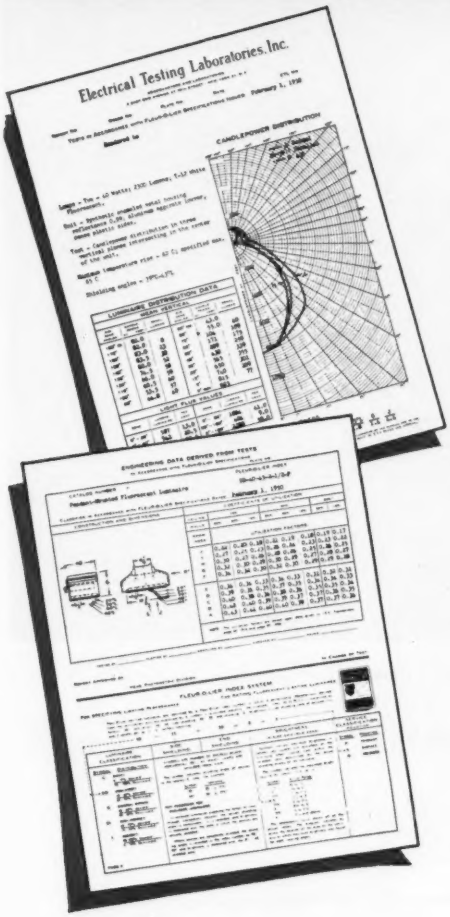
All this essential information lets you know in advance just what you're getting when you specify Fleur-O-Lier.

FLEUR·O·LIER

Manufacturers

2116 Keith Building • Cleveland 15, Ohio

Fleur-O-Lier is not the name of an individual manufacturer, but of a group of fixtures made by leading manufacturers. Participation in the Fleur-O-Lier program is open to any manufacturer who complies with Fleur-O-Lier requirements.



FLEUR-O-LIER DATA SHEETS give complete information

Manufacturers of Fleur-O-Lier fixtures provide Standard Data Sheets which give complete and detailed information on each Fleur-O-Lier fixture. Here, brought together on one sheet, is everything you need to know about the fixture—shielding—brightness—light distribution data—utilization factors—and construction and dimension details.

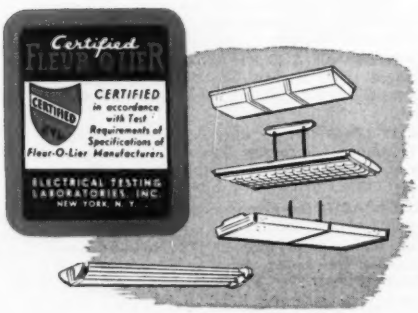
With more than 300 Fleur-O-Lier fixtures available from 25 different manufacturers—you have a wide selection of units to meet the needs of any installation.

How the Fleur-O-Lier System Enables You to Specify and Select the Right Units

The Fleur-O-Lier Index System makes the specification and selection of lighting fixtures extremely simple. Merely ask the specification writer to express the desired illumination characteristics in the simple formulas of the Fleur-O-Lier Index System.

Then the selection of lighting equipment that fits exactly the requirements of the installation is easy. Choose from fixtures that have the requested Fleur-O-Lier Index System formula and you know you'll get the desired lighting results.

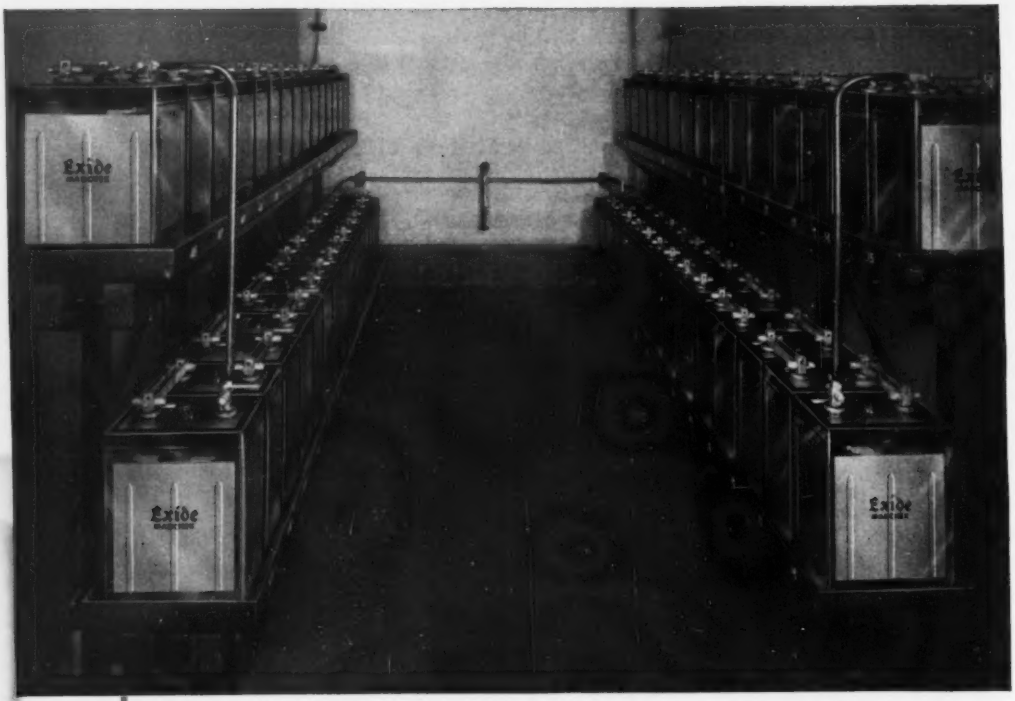
Don't take chances . . . specify Fleur-O-Lier and *know* what you're getting!



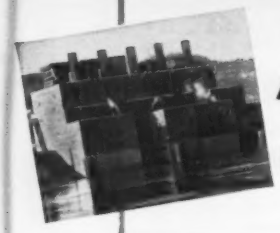
Free Booklet

Write for your free copy of the new booklet giving complete details of the Fleur-O-Lier Index System.

Ask also for Electrical Testing Laboratories' report on performance ratings assigned to the 300 Fleur-O-Lier fixtures.



Duquesne Light Company's Phillips Power Station, South Heights, Pa. Breaker control battery is 60-cell FME-17 Exide-Manchex. Rack is Exide 37344, 2-step.



AT DUQUESNE LIGHT COMPANY'S Phillips Power Station

breaker control battery is Exide-Manchex

Another great utility turns to dependable Exide-Manchex Batteries. In Duquesne Light's modern Phillips Power Station, located on the Ohio River near Pittsburgh, positive switchgear operation is assured by a 60-cell FME-17 Exide-Manchex Battery. This battery controls switchgear of 69 KV, 1200 Amp. breakers, and is set up for emergency duty on motor operated steam valves.

This is just one of the many modern stations throughout the country where dependable performance is provided by Exide-Manchex Batteries. Consider these benefits from Exide-Manchex.

POSITIVE OPERATION: Power is delivered at high or low rates, providing dependable performance at ample voltage with no switching failures.

INSTANTANEOUS POWER, capable of discharging at high rates for switchgear operation and of providing adequate reserve power for the dependable performance of all other control circuits and also emergency lighting.

LOW OPERATING COST: Extremely low internal resistance. Power required to keep battery floated and fully charged ranges between 0.25% and 1.0% of the 8-hour discharge.

LOW MAINTENANCE AND REPAIR COSTS: Water required about twice a year. No change of chemical solution needed during life of battery. Repair costs negligible.

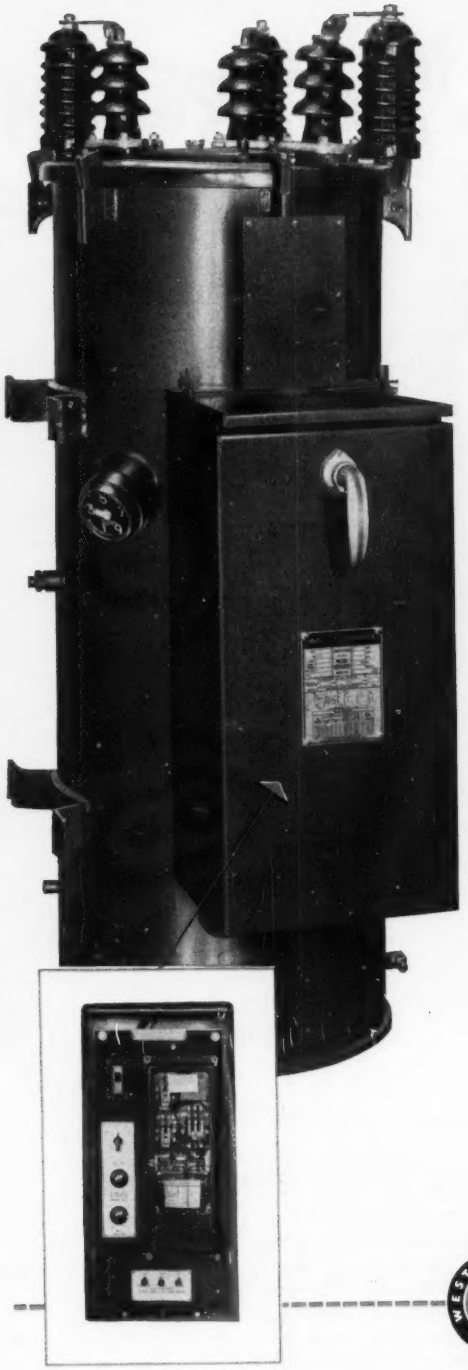
UNUSUALLY LONG LIFE . . . due to sturdy construction; the famous manchester positive plate; a combination of specially treated wood and plastic separators; and other exclusive features.

GREATER CAPACITY in a given amount of space avoids overcrowding of equipment.

These are the features that help to make Exide-Manchex *your best battery buy* for all control and substation services.

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 2
Exide Batteries of Canada, Limited, Toronto
"Exide" and "Manchex" Reg. Trade-marks U. S. Pat. Off.

1888 . . . DEPENDABLE BATTERIES FOR 63 YEARS . . . 1951



MOUNT IT ON ONE POLE...

SAFELY

The URL-8 Feeder Voltage Regulator, due to its light weight, can be mounted safely on *one* pole. Improve voltage regulation in rural areas . . . with minimum installation costs. Simplified construction, including a lightweight Hipersil® core, now makes this possible . . . assures the weight reduction necessary for one-pole mounting.

Along with lower installation costs, you get these additional advantages:

Simplified Tap Changing and Control: Simple, direct tap changer drive cuts maintenance to a bare minimum. Control is automatic. Control cabinet may be mounted on the regulator or separately on the pole.

Improved Regulation . . . Voltage Control: New voltage-regulating relay provides suitable inverse time-delay before initiating tap change. Separate resistance and reactance line drop compensation is adjustable by individual dials.

Convenient Drawout-Type Flexitest Mounting: New package control is mounted in a handy, drawout-type flexitest case. Assembly can be removed as a unit to be tested or repaired, or a stand-by unit can be inserted in a matter of seconds. A manual control is provided for aid in making relay adjustment.

Get complete information on these and other advantages from your Westinghouse representative, or write for Catalog 47-430. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-70585

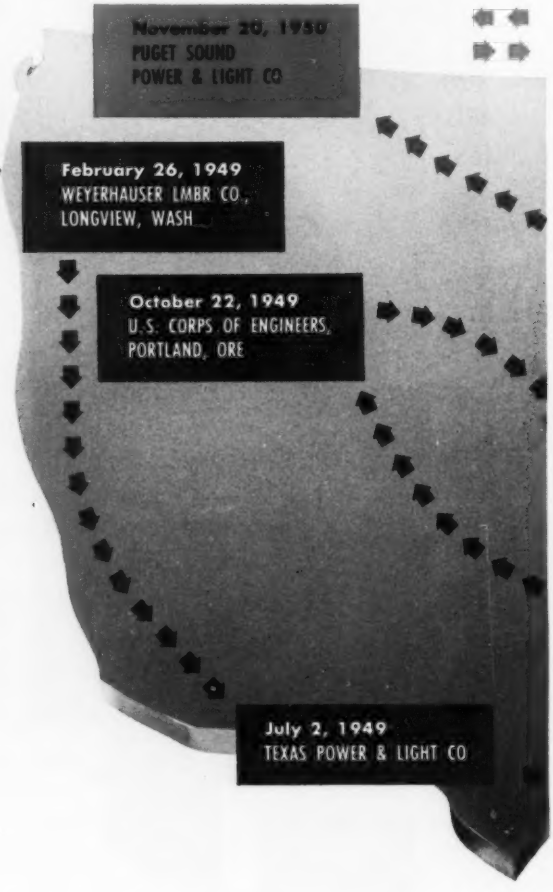
YOU CAN BE SURE... IF IT'S

Westinghouse

VOLTAGE REGULATORS

America's "INTER-COM

The business press is the inter-communications system of American Industry. Here is one of its greatest components doing its most important job.



We think the most important function of good industrial reporting is to stimulate *more* good reporting—to start the "chain reaction" which brings about the swift, nation-wide interchange of knowledge without which industry would stand still.

For example: Public Service Co. of Northern Illinois started experimenting with buried cable 13 years ago. Since then, this company has plowed in 160 circuit miles of buried cable and accumulated over 1,000 mile-years of buried-cable experience on rural and urban circuits—more, in fact, than any other company. (Interest in buried cable is growing fast because it eliminates the eyesore and wind and ice hazards of overhead, yet costs less than full-scale underground).

Everything this company learned about installation and maintenance—about failures and cost—was finally released in two cogent articles in Electrical World.

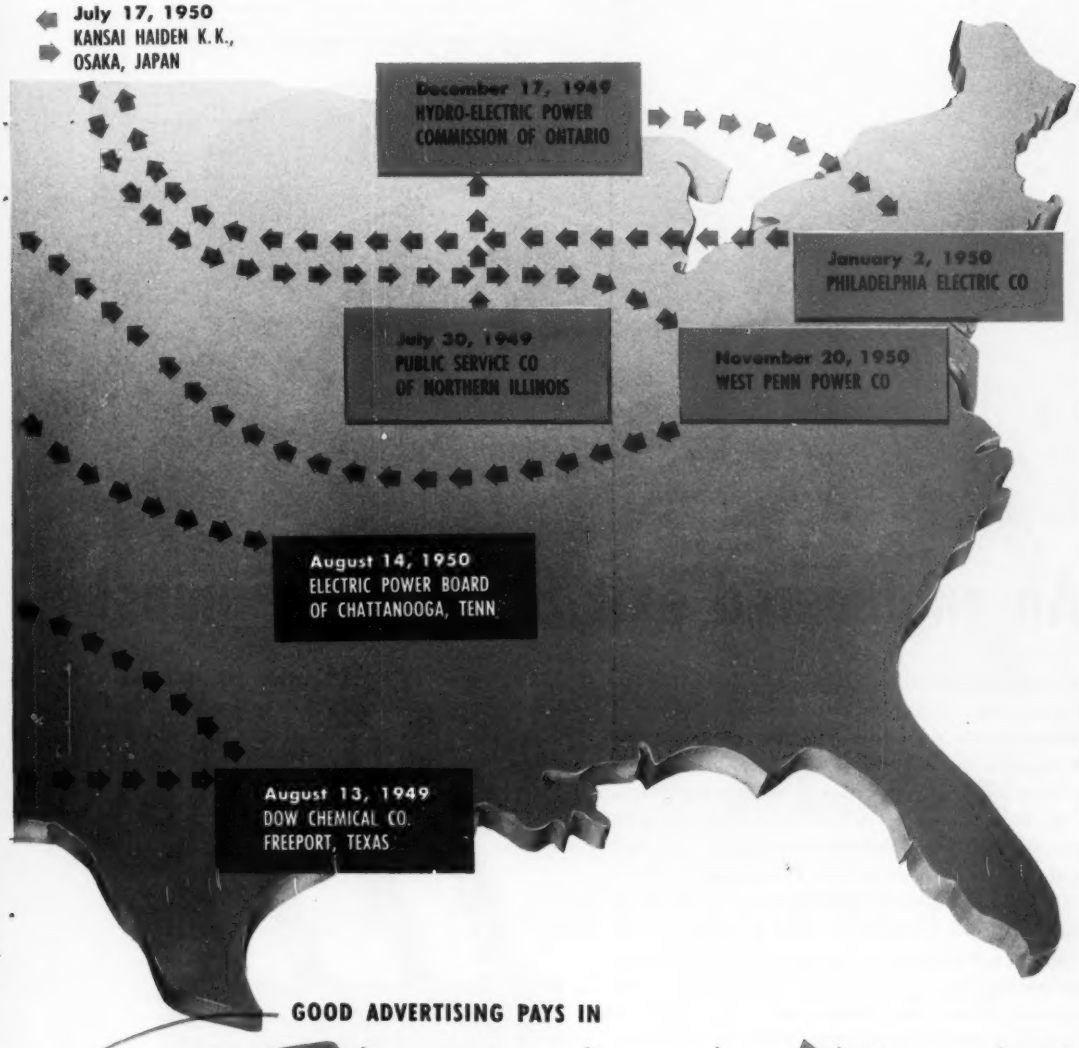
Even more important than sharing this fund of knowledge with the whole industry is the fact that these articles set off a *chain reaction* which quickly brought in five more invaluable accounts of buried-cable experience, revealing different problems, different circumstances, different solutions. You can trace them in red on the map. One we can't show came from an electrical engineer named Tanaka in Osaka, Japan.

Another 1950 series of great "chain reaction" stories was on aerial cable in industry (also a focal-point of interest). This chain was started by an article from Electrical World's West Coast editor. You can trace it in black on the map.

We could cite many more such examples, because a most important result of good industrial reporting is to stimulate *more* good reporting—to concentrate all available industry knowledge in one source.

Good industrial journalism impels the same interest and action in its advertising pages. For action in the Great Growth Industry, throughout America,

SYSTEM" at work



GOOD ADVERTISING PAYS IN

ABC · ABP **Electrical World**

A McGRAW-HILL MAGAZINE McGRAW-HILL BUILDING, NEW YORK 18

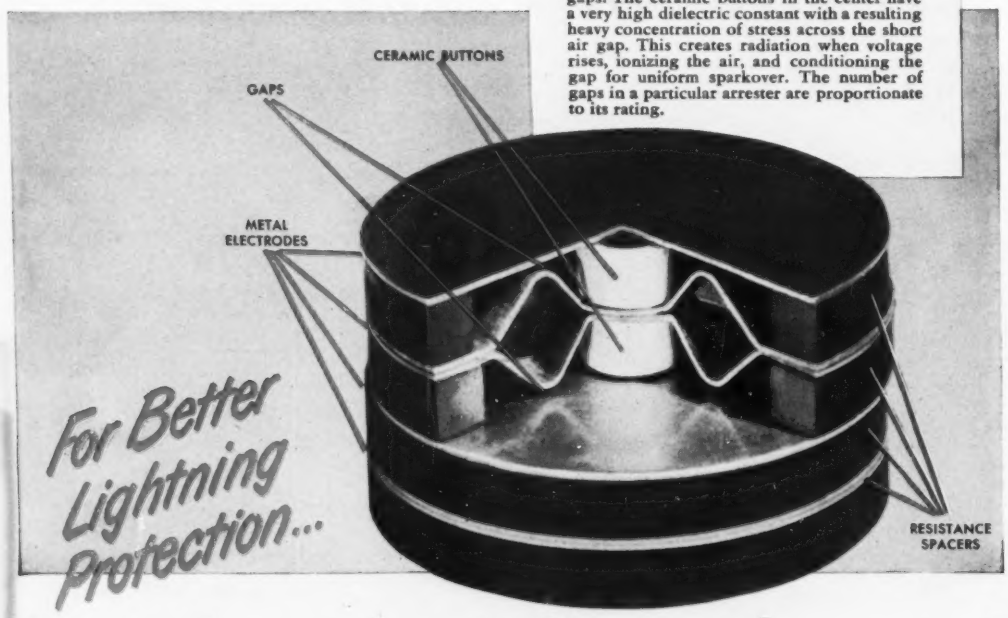
JOURNAL OF THE GREAT GROWTH INDUSTRY FOR 77 YEARS

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

HERE'S HOW IT WORKS

View shows two sections of the "pre-ionized gap" with one cut away to show gap arrangement. The high resistance spacers allow for a constant flow of a small leakage current, which equally divides the voltage across the series of gaps. The ceramic buttons in the center have a very high dielectric constant with a resulting heavy concentration of stress across the short air gap. This creates radiation when voltage rises, ionizing the air, and conditioning the gap for uniform sparkover. The number of gaps in a particular arrester are proportionate to its rating.



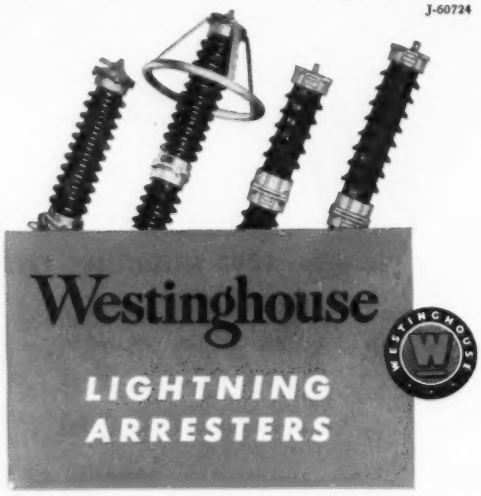
An engineered exit for impulse amps!

We call it the "pre-ionized gap"... this hidden feature that assures *low and consistent sparkover* in Westinghouse Valve-type Arresters. It's exclusively Westinghouse and it offers a *sure* way to provide *complete* protection for your valuable system equipment.

In Westinghouse SV and LVS Arresters the gaps are arranged for low sparkover on impulse and high sparkover on 60-cycle voltage. The gaps are enclosed in a porcelain tube with metal caps solder-sealed on each end. Seals are pressure-tested to make sure no moisture will enter in service; and before final sealing, the assembly is purged with dried air to exclude initial moisture. There is never need for internal maintenance.

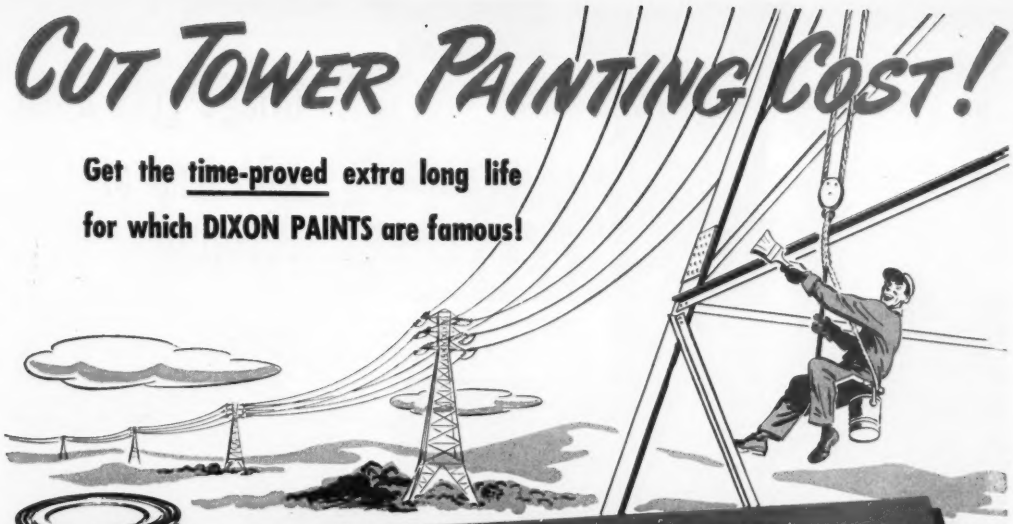
For complete information on LVS (20 to 73 kv) and SV (3 to 242 kv) Arresters, ask for bulletins DB 38-120 and DB 38-130, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-60724



CUT TOWER PAINTING COST!

Get the time-proved extra long life for which DIXON PAINTS are famous!



Available in black, aluminum and gray

THESE DIXON PAINT SERVICE RECORDS ARE TYPICAL!

✔ 7 YEARS SERVICE
Utility transmission towers. Severe fume and salt water conditions.

✔ 16 YEARS SERVICE
3½-mile bridge. Highly concentrated industrial area.

✔ 6 YEARS SERVICE
(and Dixon Paint still going strong!)
Gas plant located on ocean front.

✔ 14 YEARS SERVICE
Catenary system of large, well-known railroad.

✔ 7 YEARS SERVICE
(and Dixon Paint still O.K.!)
5,000,000 cubic foot gas tank.

✔ 17 YEARS SERVICE
Railroad bridge spanning bay.

HERE'S WHAT YOU GET IN THESE PAINTS:

1. The time-proved ability of *Natural* Flake Silica Graphite to protect towers against punishing weather and atmospheric conditions. Service records of 7 years or more are not unusual.

2. Almost a century of specialized experience... concentrated on the job of making better *outdoor paints for metal.*

Dixon Primers and Paints are especially developed for transmission towers and all outdoor metal structures.

For applications where a one coat system is indicated, Dixon's one coat paint offers an effective, economical means of surface protection.

SEND FOR THIS NEW, USEFUL ENGINEERING MANUAL ON TRANSMISSION TOWER PAINTING—it's a working guide to efficient, economical protection of transmission towers against corrosion. Contains valuable information never published before. Data and formulas included for calculating cost elements. Result of comprehensive field survey and research. Use coupon or write for copy.

DIXON

FLAKE SILICA GRAPHITE

PAINTS

JOSEPH DIXON CRUCIBLE COMPANY
Paint Division, Jersey City 3, N. J.

Gentlemen: ☐ Without obligation please send me a copy of your new engineering manual "Transmission Tower Painting."

☐ Have your salesman call on me.

COMPANY_____

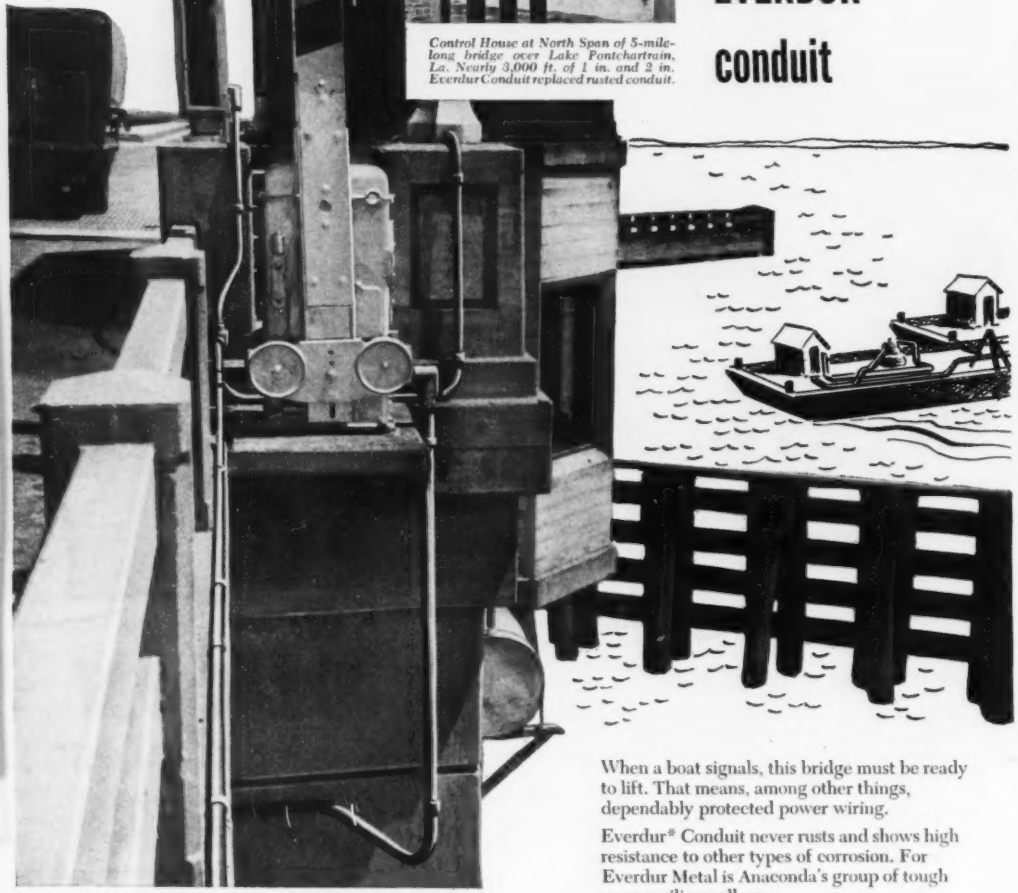
ADDRESS_____

NAME_____ TITLE_____

SPECIALISTS IN OUTDOOR PAINTS FOR METALS—FOR ALMOST A CENTURY

Bridge gets a lift with help of EVERDUR conduit

Control House at North Span of 5-mile-long bridge over Lake Pontchartrain, La. Nearly 3,000 ft. of 1 in. and 2 in. Everdur Conduit replaced rusted conduit.



Near side of North Span, showing 2 in. Everdur Conduit to gate and 1 in. Everdur Conduit to roadway warning light. Electrical contractor: W. J. Barnes Electric Co., New Orleans, La.

When a boat signals, this bridge must be ready to lift. That means, among other things, dependably protected power wiring.

Everdur* Conduit never rusts and shows high resistance to other types of corrosion. For Everdur Metal is Anaconda's group of tough copper-silicon alloys.

Wherever corrosion resistance combined with high strength is required, you ought to consider Everdur. In addition to Rigid Conduit and EMT, Everdur is available in most wrought commercial shapes and in casting ingots. It is easily fabricated by all the usual methods, including oxyacetylene and electric arc welding. For detailed information, just ask The American Brass Company, Waterbury 20, Conn. In Canada, Anaconda American Brass, Ltd., New Toronto, Ont.

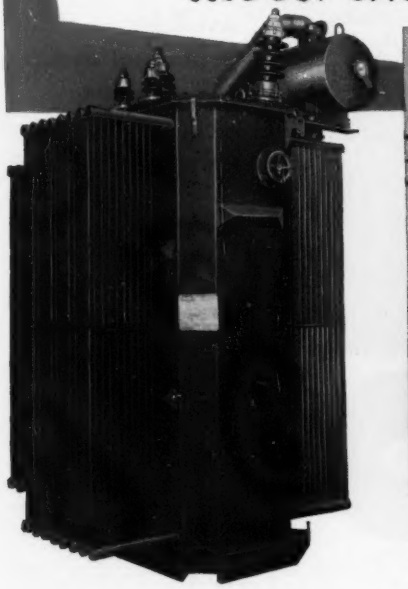
*Reg. U. S. Pat. Off. 50142

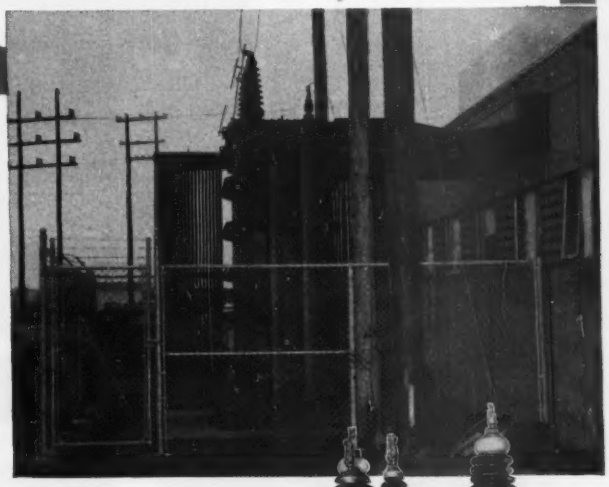
Where corrosion resistance counts—consider Everdur

ANACONDA®
COPPER-SILICON ALLOYS

Wagner Transformers

...best choice for Rural Systems





7500 kva, three-phase Wagner Power Transformer in the substation of a generating co-op in the Northwest.

. . . They have the stamina to perform dependably under ever-increasing loads

Wagner Transformers are favorites with hundreds of rural line systems throughout the country. Whether you need power transformers for generating plants—substation transformers for feeding distribution lines—or pole type transformers along the lines . . . you can't beat Wagner Transformers. They require only a minimum of attention, and they have a nationwide reputation for long life and stamina. This reputation is backed by service records from the field and by sixty years of transformer building experience.

Above is a 2000 kva Wagner Power Transformer.

At right is pictured a Wagner single-phase Substation Transformer—like those serving with complete dependability on rural line systems everywhere.

If you are planning to increase the capacity of your system, check the many advantages of Wagner Transformers. Bulletins TU-180 and TU-181 give full information. Be sure to get your copies.

Wagner Electric Corporation
1891 WE 1951

WAGNER ELECTRIC CORPORATION
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.
ELECTRIC MOTORS - TRANSFORMERS - INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS - AIR AND HYDRAULIC

BRANCHES IN 31 PRINCIPAL CITIES

DUTCH BRAND PLASTIX *Electrical tapes*

Available in practical sizes and packaging for contractors and industrial users.

Regular .007 Plastix for general service or .010 Plastix for Heavy Duty

The newest electrical tape in the line . . . High Dielectrical Resistance per mil of thickness . . . conforms readily to irregular surfaces. You'll find it an ideal tape for use in those many places where space is limited. **PLASTIX** stands up under severest conditions and resists water, oil, acids, alkalies and corrosive chemicals.

The new .010 **PLASTIX** Electrical Tape is slightly thicker for heavy duty work such as winding heavy cables, electrical harness or for use with power driven taping machines.

Both DUTCH BRAND **PLASTIX** ELECTRICAL TAPES are the result of careful study and research and meet the recognized high quality standards established by all other DUTCH BRAND electrical tapes.

REGULAR PLASTIX FEATURES THESE MANY OUTSTANDING QUALITIES

Tears Readily . . . In spite of its strength and stretch.

Conforms to Irregular Surfaces . . . great flexibility and stretch make excellent conformity.

Resists Weather . . . rain and rough weather do not affect it . . . favorably withstands relatively high or low temperatures.

Resists Oils, Acids, Alkalies, Corrosion . . . wherever present . . . in chemical plants, around machinery, etc.

High Dielectric Resistance, where space is limited . . . a single thickness resists 8000 volts which is greater than 1000 volts per mil of thickness.

Excellent Adhesion . . . the quality of the adhesive and the even coating assure excellent adhesion.

Tensile Strength . . . it is strong . . . has ample strength for all types of applications.

.010 PLASTIX ELECTRICAL TAPE CHARACTERISTICS

All general characteristics are the same as above except .010 PLASTIX is heavier gauge for heavy-duty work.

Thickness .010"
A single thickness resists 10,000 volts

For complete satisfaction order DUTCH BRAND **PLASTIX** ELECTRICAL TAPE by name . . . specifying either the regular .007 **PLASTIX** or heavy duty .010 **PLASTIX**.

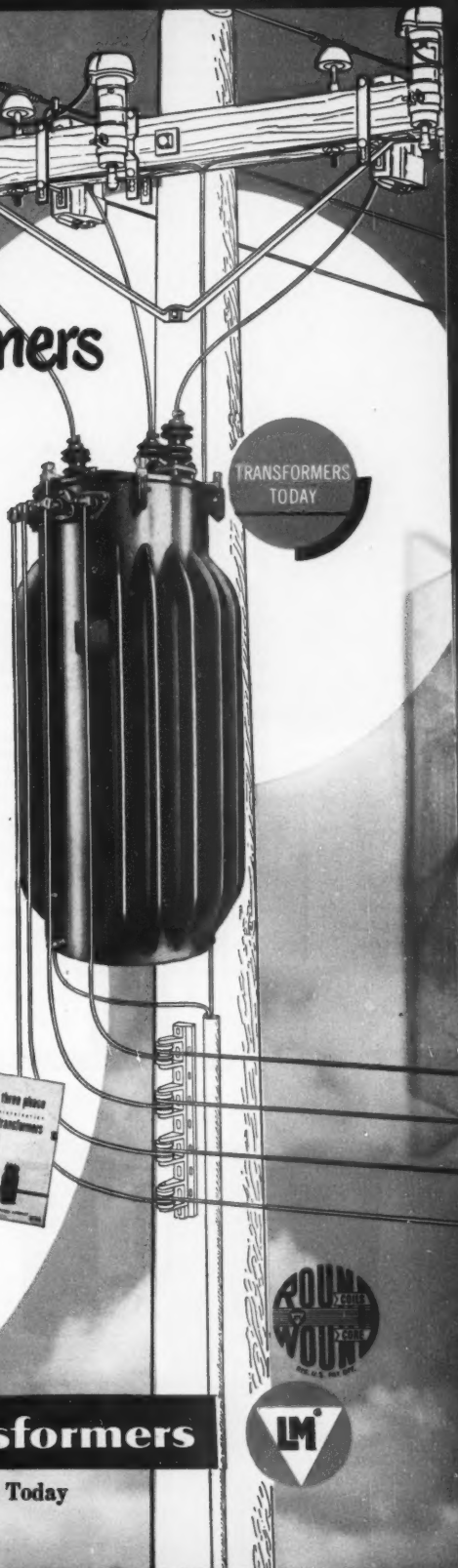
The Three Electrical Tapes
Friction—**PLASTIX**—Rubber
to meet all requirements

ORDER FROM YOUR JOBBER

DUTCH BRAND

VAN CLEEF BROS. INC.
Manufacturers . . . Rubber Products . . . Est. 1910
CHICAGO 19, U. S. A.

YOU MAKE THESE 3 SAVINGS WITH L-M 3-phase Transformers



1. INSTALLATION:

It's simpler to hang and wire one 3-phase transformer than a bank of three single-phase units—and it's safer, too!

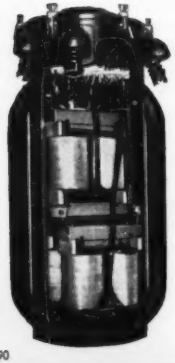
2. POLE SPACE:

L-M sizes through 112½ kva can be bolted directly to the pole. You eliminate additional cross arms and get greatly improved appearance.

3. OPERATING COST:

The impedances of all three units in a 3-phase transformer are identical. This eliminates the circulating currents and losses in operation which may occur in banks of three single phase units.

Perhaps you, like many others, would like more information on the relative advantages of 3-phase transformers and single-phase banks. If you care to drop your problem in our lap, we'll be glad to work with you. Ask the L-M Field Engineer, or write Transformer Division, Line Material Co., Zanesville, Ohio (A McGraw Electric Company division).



Ratings from 9 to 150 kva have famous L-M "Round-Wound" construction with its many advantages. Ratings from 225 to 500 kva have *round* coils on a three-legged stacked core; these offer many advantages not inherent in square-coil construction. For data and dimensions write for Bulletin DT5.

Three core-coil units mounted in one rigid frame, for best cooling and maximum accessibility. Any one of the three units may easily be removed and replaced if necessary.

7590

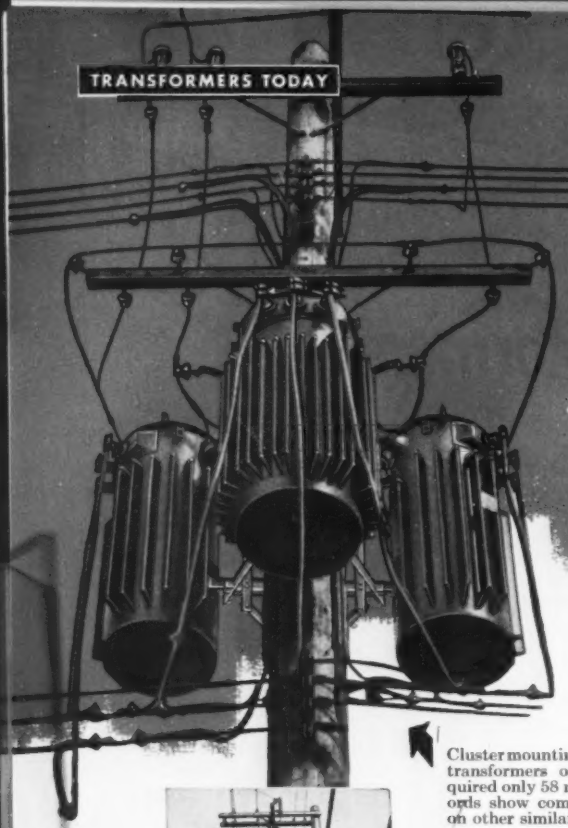
LINE MATERIAL... Transformers

Complete Coordinated Equipment for Distribution Today

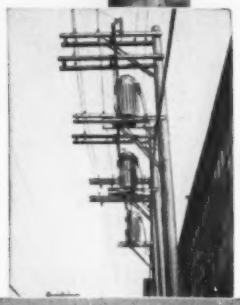
TRANSFORMERS TODAY

HOW TO hang 3 Transformers on one pole AND SAVE 24 MAN-HOURS

by George Hindman,
Estimating Supervisor,
Overhead Lines Department,
Detroit Edison Company.



Cluster mounting of three 75 kva transformers on one pole required only 58 man hours. Records show comparable savings on other similar installations.



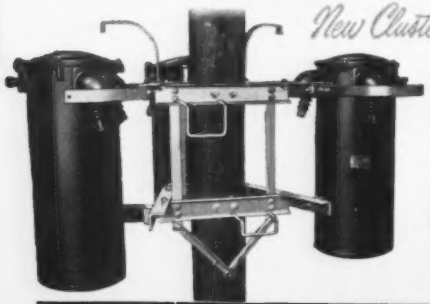
The Old Way

The old way—hanging these three 75 kva transformers on three poles required 82 man hours.

To avoid the increasing use of two-pole platforms for transformer banks, the author developed the idea of supporting two or three single phase transformers on a single pole with a specially designed hanger.

This is now readily done with the L-M Cluster Mounting Frame, which holds from two 25 kva up to three 100 kva transformers. The frame balances the load and provides adequate climbing space.

Its use results in a *substantial saving* in labor and material, through elimination of heavy primary and secondary busses, extra poles, platforms, etc. *Electrical characteristics* are improved because the transformer bank is mounted nearer its load, effecting a saving in secondary copper and improving secondary voltage. Appearance is improved as well, by L-M's Cluster Mounting Frame.



New Cluster Mounting Frame

The new L-M Cluster Mounting Frame, which hangs anywhere from two 25 kva to three 100 kva transformers on a single pole. This bracket was developed from the idea of George Hindman of Detroit Edison Company. Mr. Hindman was awarded Detroit Edison's Alex Dow award for this idea.

For further information ask the L-M Field Engineer or write Transformer Division, Line Material Co., Zanesville, Ohio, for Bulletin 49001. (Line Material is a McGraw Electric Company Division.)

7589

LINE MATERIAL ... Transformers

Complete Coordinated Equipment for Distribution Today

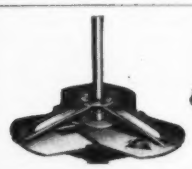
LM

The Most Important Guy in Line Construction

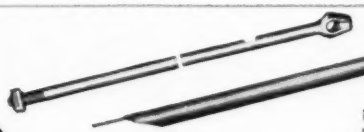
● L-M makes a wide variety of line construction materials. But none are more important than L-M guying equipment, for if the guy goes, the line goes.

So L-M guy hooks, attachments, clamps, and rods are made of high quality materials, heavily hot-dip galvanized under precisely controlled conditions.

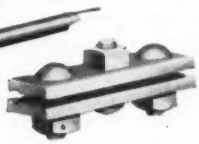
L-M, one of the great names in electrical equipment research, is also one of the great names in line construction materials. L-M materials are recognized for their strength and dependable high quality. They are available for prompt shipment through 77 L-M sales offices and warehouses throughout the country.



3-Way Expanding Steel Guy Anchor



Steel Single Strand Eye Anchor Rod



Steel Guy Wire Protector

Guy Clamp with Torkol-treated Nuts

Angle Single Strand Eye Bolt

Galvanized Steel Lift Plate

● Line Material offers a wide variety of line construction hardware and specialty items to solve almost any construction problem. Ask the L-M Field Engineer for details and bulletins. Or write Line Material Company, Milwaukee 1, Wis. (a McGraw Electric Company Division).

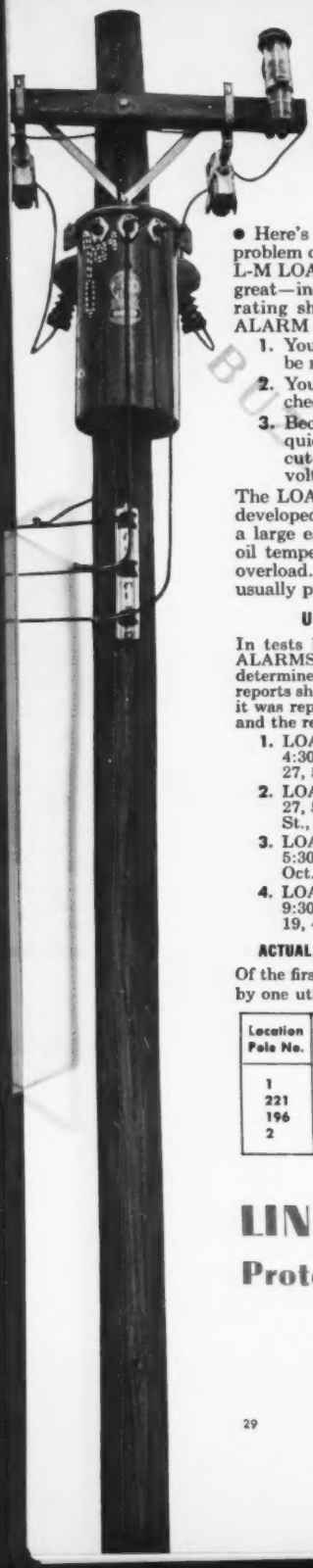
25-R

LINE MATERIAL...

Line Construction Materials

Cut Transformer Burnouts... Cut Load-Check Costs...with NEW

L-M TRANSFORMER LOAD-ALARM*



● Here's the simple, economical answer to the problem of locating overloaded transformers. The L-M LOAD-ALARM signals when the load is too great—indicating that a transformer of higher kva rating should be installed. Using the LOAD-ALARM means:

1. You save transformers because they can be replaced before they burn out.
2. You eliminate the need for costly load checks to locate overloaded transformers.
3. Because overloaded transformers can be quickly located and then replaced, you cut down the number of customer low voltage complaints.

The LOAD-ALARM is a simple, thermal device developed by L-M engineers in cooperation with a large eastern utility company. It operates on oil temperature rise caused by prolonged heavy overload. It emits an audible signal which is usually promptly reported by the customers.

UTILITY MAKES TIME-CLOCK TESTS

In tests by a large eastern utility, L-M LOAD-ALARMS were set by time clock to operate at predetermined times of the day. Following are a few reports showing time the alarm began operating, time it was reported, and location of the test transformer and the reporter's residence.

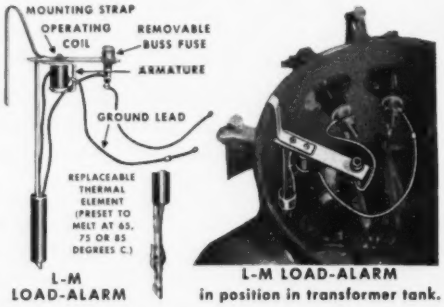
1. LOAD-ALARM at 371 Villa St., Sept. 27, 4:30 P.M. Reported from 361 Villa St., Sept. 27, 5:20 P.M.
2. LOAD-ALARM at 133 Knowlton St., Sept. 27, 5:00 P.M. Reported from 129 Knowlton St., Sept. 27, 5:08 P.M.
3. LOAD-ALARM at 61 Grosvenor, Oct. 7, 5:30 P.M. Reported from 40 Belmont St., Oct. 8, 10:00 A.M.
4. LOAD-ALARM at 105 Hickory, Oct. 17, 9:30 A.M. Reported from 111 Hickory, Oct. 19, 4:00 A.M.

ACTUAL OVERLOADS REVEALED BY LOAD-ALARMS

Of the first 15 LOAD-ALARMS put in actual service by one utility, four operated under these conditions:

Location Pole No.	ALARM Reported by	Transformer Rating	Actual Load
1	Customer	15 Kva	28 Kva
221	Employee	15 Kva	27 Kva
196	Several customers	15 Kva	29 Kva
2	Several customers	50 Kva	85 Kva

"Use of this device allows us to make greater use of our transformer capacity," says one of this utility's district superintendents. "It allows us time to make secondary surveys before changing transformers. Necessary replacements can be made during normal working hours instead of on overtime, and long interruptions and burnouts and resulting rewinding costs are eliminated."



L-M LOAD-ALARM

L-M LOAD-ALARM in position in transformer tank.

Continuous overload causes the oil temperature to rise. When oil temperature reaches the predetermined melting point of the alloy thermal element, the alloy melts, setting off the buzzer. Transformer acts as sounding board; secondary conductors carry the sound to connected structures. When customers phone (and they do!) lineman removes the fuse through the handhole, silencing the buzzer until it is convenient to make a load check and install a transformer of higher rating.

TRY IT YOURSELF!

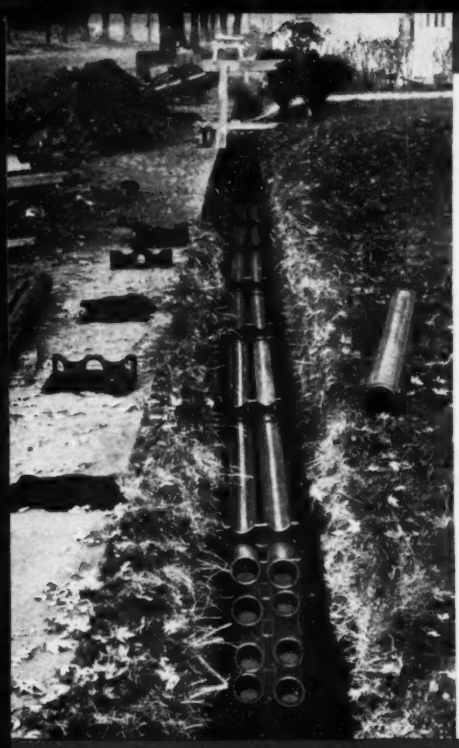
L-M LOAD-ALARMS cost about $3.00. Order enough for a test, right now. Order from the L-M Field Engineer or direct from Line Material Co., Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

*Trademark

LINE MATERIAL

Protective Equipment

LM



for faster underground installations

New L-M Spacers

New L-M Base Spacer:

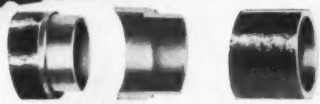
assures rigid foundation, desired gradient. Interlocking ends; wide flat base—the spacer will not tip over during or after installation. All L-M spacers come in standardized cartons to save stockroom handling and space. Available from stock, in six standard sizes.

New L-M Intermediate Spacer:

made of asphalt and asbestos fibre, highly resistant to acids and alkalis, fire resistant, Underwriters' listed. Withstands vertical flat crushing test of over 1200 pounds. Grooved ends lock together with the next spacer; centers notched for sawing.

New L-M Bend Spacer Bar:

a duct-installation leveller, used horizontally or vertically for accurate alignment of conduit around bends. Saves hours of work in lining up. Offers a tremendous saving in installation labor costs. L-M exclusive. 20" long, 1½" square, easily sawed to length.



New L-M Multi-Use Bend Sections and Angle Couplings:

use in any combination to make all kinds of special bends and crossovers. Male and female tapers offset 2½°, giving 5° bend in each section. Smooth inside, watertight tap-tite joints.

The L-M System makes Fibre Conduit *so easy to use*

New L-M Fibre Conduit Vise

An easy, safe way to hold fibre conduit for sawing or tapering. For mounting on truck or bench, or with detachable tripod for use in the field, on the job.

With L-M Fibre Conduit and L-M equipment and tools, L-M's system speeds up underground installations, makes better jobs.

L-M Fibre Conduit is strong, light, tough; yet it's easy to taper and cut to length. L-M base spacers, intermediate spacers, and bend spacers assure a firm foundation and a rigid structure that won't settle or shift.

L-M tools save hours of time in the shop and on the job. Better get the low-down on this high-class, time-saving equipment.

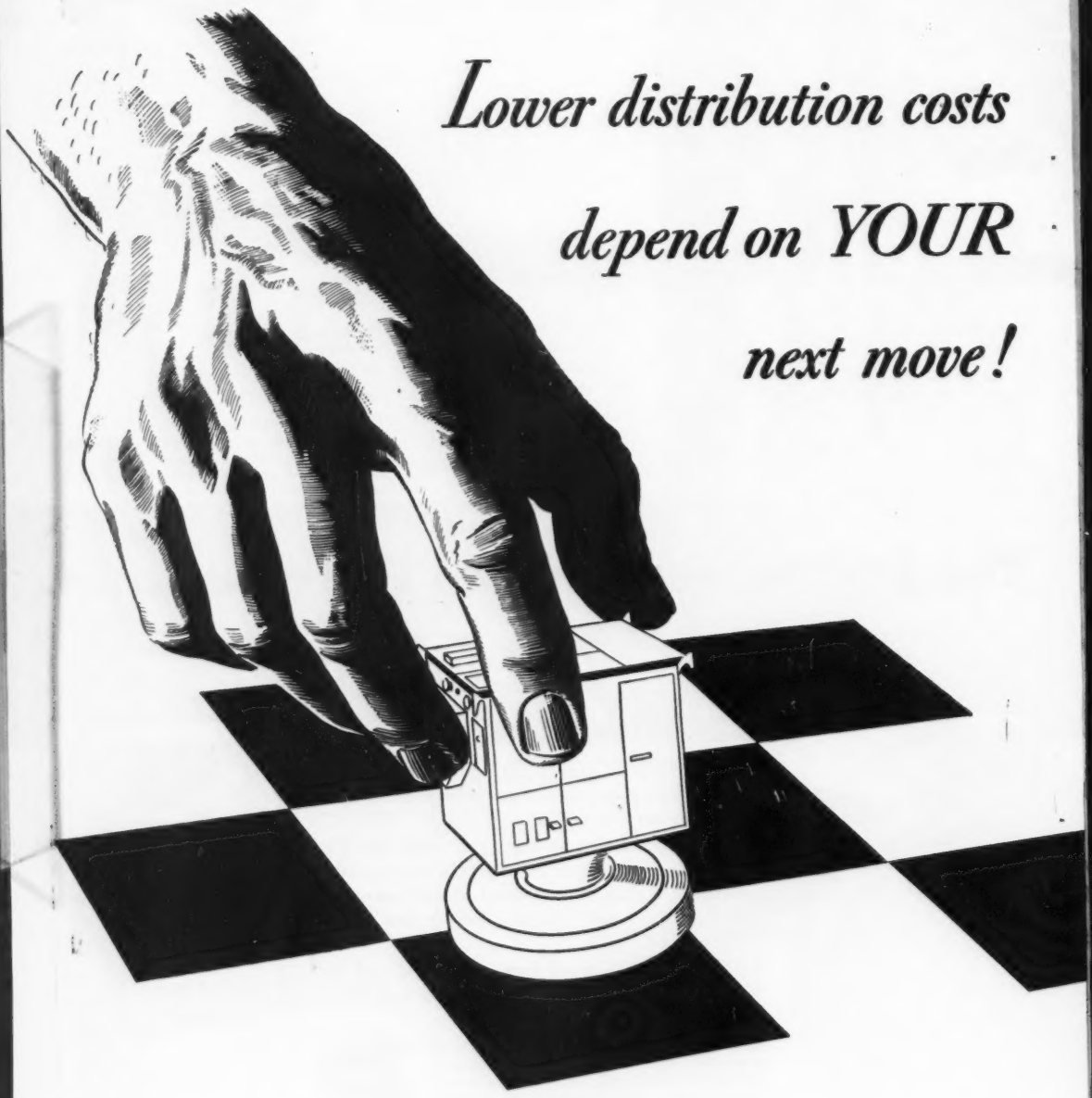
GET THIS FREE HANDBOOK! Pocket-size manual covers recommended underground construction practices; contains valuable reference tables. Ask the L-M Field Engineer for a copy, also for new Fibre Conduit folder; or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

New L-M Tapering Tool

Cuts a precise 2° taper on the end of conduit to assure tight, snug joints. Light; easy to use; saves time; cuts costs by salvaging cut ends and short lengths quickly.

LINE MATERIAL... Fibre Conduit

Complete Coordinated Equipment for Distribution Today


Lower distribution costs
depend on YOUR
next move!

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

. . . and there is only one way to make it count! *Have a modern system planned before you expand or make replacements to your present system.*

Loads may quadruple in the next 25 years. This means your present system will be virtually replaced within that period. So when you plan ahead . . . seek system and equipment characteristics that will enable you to cope with expanding loads *economically!*

There are several logical objectives at which you may aim:

A simplified system: Today's trend toward simple loop or radial subtransmission patterns seems certain to effect sharp cuts in distribution costs. Complex interconnections are eliminated. The cost of equipment at numerous system tie points is saved. And the inherent simplicity of these systems promises substantially lower operating and maintenance costs. What's more, the simplified system permits employment of a second important, cost-saving tool:

Standardized, factory-assembled substations . . . which utilize less equipment . . . provide for less costly bus regulation, and allow for shorter distribution feeders because you can bring high voltage closer to the load. And this is important! Standardized substations provide the flexibility needed to achieve simplification in other parts of the system. Spot networks, secondary networks and the use of banked secondaries are typical opportunities open to farsighted system planners.

Let these facts be your guide as you plan for the future . . . and let Westinghouse help. Our engineers and complete system planning facilities are at your service. Just call your Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-97146

WRITE FOR A PRESENTATION OF THIS VALUABLE INFORMATION

"Electric Utility Power Distribution System," B-3903
"Co-ordinated Substations," B-4061

Westinghouse

SYSTEM PLANNING SERVICE

The Defense Production Problem

To win out in the struggle for freedom into which the Russian Communists have plunged us we must do at least four things. We must:

1. Speedily carry through a program of defense production which, at its peak, is scheduled to take about one-fifth of our national output.

2. Pay for this program as we go, by methods that will enable us to maintain the effort for an indefinite period – as long as may be necessary to insure peace and security.

3. Manage intelligently and endure intelligently a set of direct government controls which, in certain critical departments, will put our national economy for a time in a hateful straight jacket.

4. See that these emergency controls are not fastened upon us permanently thereby presenting to our Soviet antagonists a major victory for collectivism on our home front.

This is the first of a series of editorials designed to present in the simplest terms these key aspects of our struggle to preserve our free institutions.

A Staggering Task

The magnitude of the defense production job staggers the imagination. Over the next year it calls for a larger volume of goods and services than the 20 million people of the states of New York and New Jersey will use for all purposes. The (London) TIMES has observed that, taken alone, the increase of defense expenditures which has been budgeted for the federal government's coming fiscal year (about $30 billion) "is in itself not far short of the total national income of the United Kingdom."

Yet so powerful is the production machine created by free American enterprise that, at the scheduled peak, the defense program will take only about one-fifth of our total national output. The exact form and dimensions of the program will, of course, be hammered out on the anvil of public and congressional debate. But the President's recent estimate of an annual rate of expenditure of $45-55 billion for defense by the end of this year may well turn out to be somewhere near right.

To meet even these vast requirements of defense production we are in better shape technically than we were when we started to prepare for World War II. Our industrial plant and equipment is greatly improved. Over $65 billion has been invested in it since V-J Day. Our working force is about eight million larger than it was ten years ago and much better trained.

The difficulty, and it is a very serious economic difficulty, is that we must fit the defense program into a productive machine that has been almost fully extended to meet the needs of a booming civilian demand. The present plan is to step up defense production during 1951 from about 7% to about 18% of our total national output. Because there is relatively little slack in our economy, this means that civilian production at the outset must

be cut back as defense production is stepped up.

The cut-back of civilian goods must be especially severe in the case of products made of metal. This is particularly true of goods that use scarce strategic metals such as aluminum and copper. Of our total defense production program, about half will go for "military hardware" – airplanes, guns, munitions, tanks and the machinery to make them. By the end of 1951 defense requirements are scheduled to absorb most of the metalworking production not required for essential construction and for the spare parts necessary to keep existing equipment running. For a time at least, there will be a sharp cut in the supply of new metal products available to civilian consumers. The defense squeeze on both materials and manpower will also cut sharply into housing and other civilian construction.

For the Short Run — Controls

In the short run there is no answer to the problem of meeting defense production schedules except controls. Sharp reduction of non-defense expenditures by government is essential and would help greatly. But the basic fact is that we cannot increase our total production fast enough to meet immediately both civilian and defense requirements.

Controls are needed, therefore, to switch resources from civilian to defense production, and at the same time prevent the combined demand for critical products from sending prices right through the roof. In the case of many scarce strategic metals such as nickel, copper and cobalt, the task of increasing output is especially difficult because our limited supplies are tucked away deep in the earth in many quarters of the globe.

For the longer pull – and that is what we must face – there is another answer to our defense production problem that is infinitely better than controls. And this time, in contrast to World War II, it is all-important that we get the right answer to our defense production problem for the longer pull and that we get it right now. In World War II we geared our economy to meet the requirements of a relatively short and decisive conflict. Now our leaders, however they may differ as to methods, are well agreed that, at best, "the conditions under which we labor may persist for ten, fifteen or twenty years." That is General Bradley's phrase.

For the Long Pull — More and Better Production

For this longer pull, the constructive answer to our problem of defense production is clearly more and more efficient production all along the line. It is true that overall we now have the most efficient industrial establishment in the world. But, even so, much of it is far short of attainable efficiency. Some plants using up-to-date equipment and methods are as much as six times more efficient than others in the same industry that are lagging in modernization.

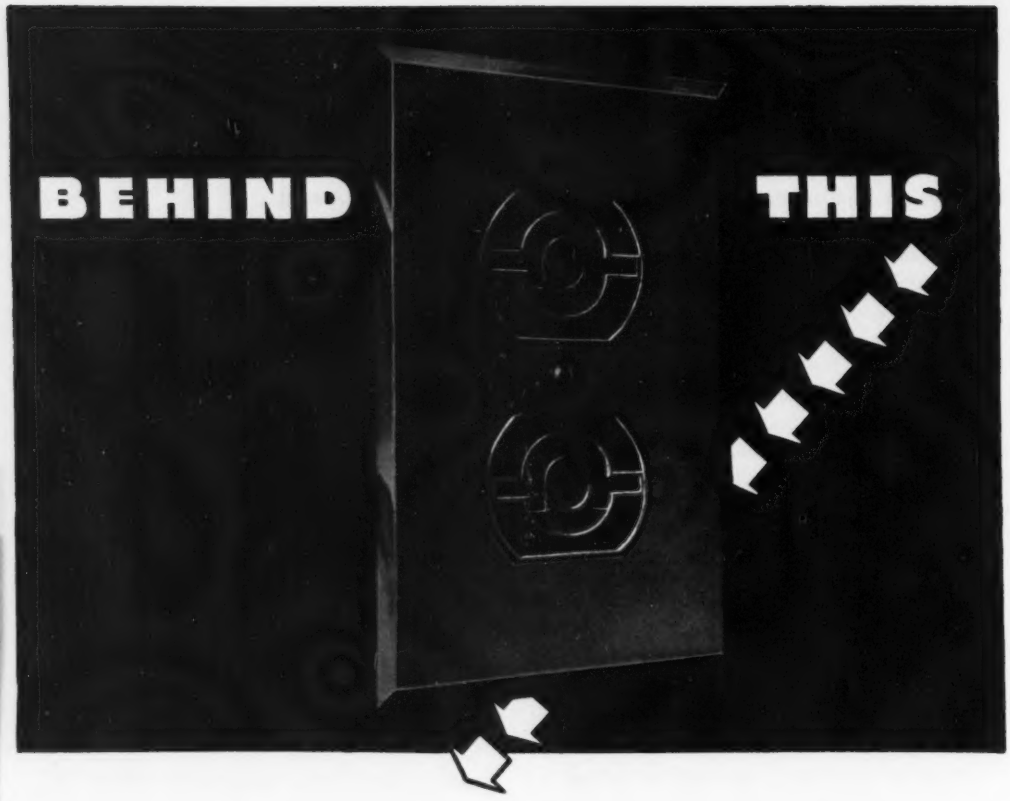
Our Director of Mobilization, Charles E. Wilson, has clearly in mind this problem of increasing our industrial efficiency. The first step in his job, as he conceives it, is to get out an adequate supply of weapons to equip the army, navy, and air forces already mobilized or in process of organization by us and our allies. The second step is to make sure of our capacity to produce both "military hardware" to meet any increased requirements and the maximum possible volume of goods for civilian use.

In concentrating on more and more efficient production, Mr. Wilson is squarely on the beam. We can attain his objective – by sustained effort on the part of each one of us backed by up-to-date industrial methods and equipment.

If we do that, we can maintain indefinitely an adequate defense effort and at the same time enjoy a standard of living higher than any other in the world.

Additional production and more efficient production are our surest safeguards against our two most menacing enemies on the home front – the deadly inflation that can destroy our free economy, and the strangling government controls that can destroy our political freedom.

McGraw-Hill Publishing Company, Inc.



. . . a dependable transformer

THE convenience outlet . . . and also the light switch . . . are commonplaces of everyday life. That an appliance will be supplied with electric power when it is plugged in, or that the lights will go on when a switch is flipped, is never doubted. Through experience we have learned to take these things for granted.

An extremely important link in the complex system required to supply electric power twenty-four hours in every single day, is the transformer. This piece of equipment must provide *unfailing* performance at all times and under all conditions . . . so that homes will have light, heat, refrigeration . . . so that industrial plants will not experience costly shutdowns.

Moloney Transformers have a reputation for providing dependable "year in and year out" service with little or no maintenance. That is why practically all of the Nation's big power systems use Moloney Transformers.

ME40-1

MOLONEY ELECTRIC COMPANY

Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers • Step Voltage Regulators • Unit Substations

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA

Editorials

How To Get Engineers

Recently a utility president wrote to the Engineering Manpower Commission and made the following statement: "We need immediately six experienced engineers and twelve junior engineers. By spring we will need at least twelve more engineers."

"Because 50% of our present technical engineers are 35 years of age or less, they might be subject to drafting for military service, unless the government recognizes our imperative need for the services of all these engineers . . .

"Even before the rearmament program was initiated it was becoming increasingly difficult for electric utilities to obtain requisite numbers of college engineering graduates."

In a speech before the Winter General Meeting of the AIEE, Titus LeClair said: "It is anticipated that 31,000 (engineers) will be graduated in 1951, and this will decrease to 15,000 in 1954 unless more high school graduates go to college, or a higher percentage than formerly choose the engineering course." LeClair urged that in informal discussions with relatives, friends, high school instructors and principals, and in vocational guidance interviews the engineering profession be presented as a "remarkable opportunity."

Addressing the same AIEE meeting, Karl T. Compton said that, ". . . in surveys of the engineering schools, in World War II, the most difficult and most continually pressing problem was to find the people who were competent and available to do the jobs." Compton went further to advocate, "a conscious effort to find promising young men and try them out in jobs of increasing responsibility as they show possibility of discharging it."

These statements are worthy of the most sincere consideration by members of the engineering profession and the utility industry. The solutions to the problem are indicated by some very specific suggestions made by men of importance. The following proposals by these men seem to have considerable merit:

Before the Summer General Meeting of AIEE, James F. Fairman said, "I suggest that each of us recognize that the great majority of engineers work for other engineers and that the latter, smaller group has a professional obligation to the larger group. Speaking as one of that group legally classified as an employer to those in similar positions, may I point out that each of us can influence, and sometimes even control, the professional development and the economic status of the engineers under our direction. Let us not be too busy to give some attention to the obligation."

Speaking at the Eta Kappa Nu dinner Jan. 22, in New York, Prof H. M. Turner of Yale said, "The starting salaries have gone up considerably; and if industry expects to get any men, they must pay considerably more. I am referring particularly to the electric utility industry."

A professor of power system engineering at an important technical school wrote the following comment to "Electrical World" in January referring to the editorial on Page 85 of the Dec. 4 issue: "I fail to see why the utilities should not be able to make offers to young engineers that are as lucrative as the offers made by industry. It seems to me that the shortage of engineers will finally develop the "Engineering Profession." There is no reason why engineers should not be in the same income or salary bracket as doctors or lawyers."

Perhaps the time is ripe for a little soul searching by engineers who are also employers.

Appliance-Starting Currents

Utility customers know their lights dip noticeably each time their refrigerator, freezer, oil burner, or air-conditioner starts. Few of them know why, but some day they may call it a nuisance, regardless of the cause or the possible remedy.

Appliance users are common customers of both the appliance manufacturer and the electric utility. What they pay over the years for their electric necessities and comforts embraces what they pay for the kilowatt hours they consume. Therefore both manufacturers and utilities have a responsibility to make that overall outlay a minimum—and an inducement to buy more of both services.

In a broad general way one component goes up as the other goes down and vice versa. Appliance motors that cause the worst dips because they are minimal designs and draw unduly heavy starting currents may necessitate undue expenditures by the utility to decrease the service impedance and the voltage dip. Conversely a superior but possibly more expensive motor (and appliance) might permit less outlay for the electric distribution system.

Somewhere between these extremes is an optimum combination of designs which will give the energy consumer and appliance user the best service at the lowest cost. This is self-evident and not a new concept at all, but progress in the art has been bringing out analyses that afford new approaches to a better overall balance than is now being obtained.

Components of the electric utility industry have conferred on this problem before, and real progress was made when limits were set for starting currents. But later studies indicate that power factor at motor-start deserves more consideration than has been given because it offers good opportunity to reduce the voltage dips. It may even prove advantageous economically to let motor locked-rotor currents be any value within limits prescribed by adequate circuit overload protection provided—. The proviso is that the power factor of the locked-rotor current be sufficiently leading to reduce the resulting starting voltage dip to values that are a lower multiple of the running voltage drop than now prevails.

Here is a basic industry problem that merits unbiased study in the interest of long term economy for the public. J. W. Anderson's article on Page 103 offers a fine point of departure for such a joint study.

The Truth Is What Hurts

In the closing speech delivered to the International Labor Conference, the president, Jagivan Ram, Indian Minister of Labor and a former untouchable, said:

"If you examine the governments of most of the countries in the world, you will find that they are not only pro-labor but most of the people who hold the reins of government belong to the labor rank. Is it at present necessary to guarantee by any statute or any convention that the worker has the right to strike? While I am saying these things to my friends in the workers' group, I do not propose that they should accept this opinion today or even tomorrow but that they should wonder whether they should not in the future lay greater emphasis not on the right to strike but on the right to work. We want more prosperity, not in individual countries but in the world as a whole, and, therefore, as has been said we will have to produce more, and in order to produce more we will have to emphasize the right to work."

The report on the conference had this to say about the labor delegates' reaction:

"The labor delegations did not like this statement. There were extreme restlessness and obvious expressions of disapproval as it was given. For a moment it appeared that some of the workers from other countries might challenge the statement from the floor. Employers who observed the incident were reminded of the old saying, 'The truth is what hurts'."

Another Job for Public Relations Men

The growth of public relations departments in electric utility companies has been rapid in the postwar period. Today companies are hiring better-trained men for this work and giving them higher stature in their organizations. Such wise management has paid off in better press relations and better customer relations. There are few companies in the nation which do not enjoy both.

But however successful public relations men have been in "selling" their companies, most of them have failed in one respect: They haven't "sold" private enterprise.

If each company president would instruct his public relations man to "sell" the private enterprise system and its advantages, not the faults of federal power and its dangers to the American people, there is no doubt that a good "selling" job would be done. And there need be no fear of a scarcity of material to "sell."

Look to Your Power Man

Industrial plant electrical engineers and managers will benefit by reading the article in this issue (p 89) by W. A. MacCalla of West Penn Power Co.—"How Power Engineers Can Help Industry Mobilize."

In this article MacCalla tells utility industrial power engineers and representatives how they can be of greatest assistance to you—their industrial customers under the present defense emergency conditions.

Perhaps, it never occurred to you that your utility's industrial power representative who calls on you *is* equipped and is expected to render the many really helpful services pointed out by MacCalla.

Perhaps, you have the mistaken impression that his main purpose in life is to "build load" and for that reason have been afraid of asking his advice on matters other than those directly connected with the incoming service?

After reading MacCalla's article you will probably ask yourself—and rightly—"Does that power man work for me—or for his company?"

The Electrical Week

INDUSTRY MOBILIZATION — NPA, operating through its Power Equipment Division, has taken control over the manufacture of heavy power equipment. NPA can cancel, change, or transfer to another manufacturer any order for such equipment on the books of any manufacturer (p 78) . . . Depa will spell out for electric utilities NPA's maintenance, repair, and operation order (p 78) . . . Interior Secretary Chapman has overruled his private power advisers in Depa. He will press for expansion of electric-energy-using industry — notably aluminum — in the power-short Northwest (p 79) . . . There is another list of M-orders on Page 79.

WASHINGTON—The St. Lawrence power project received heavy support at hearings before the House Public Works Committee (p 81) . . . Interior Secretary Chapman has been denied a rehearing on FPC's grant of a license to Virginia Electric & Power Co to develop Roanoke Rapids (p 84).

ELSEWHERE—Consumers Power Co, which serves most of Michigan, is building plant for peace, but it can be used to aid the defense program (p 80) . . . Delegates at the annual convention of the North Central Electrical Industries at Minneapolis were advised to continue their sales promotion efforts (p 82) . . . Advances in control room components were brought out at the meeting of the Electrical Equipment Committee of the Pennsylvania Electric Association (p 83) . . . With the start of delivery of Davis Dam power the Arizona Power Authority is in business (p 84) . . . BPA reports that a new 230-kv series capacitor installation has passed its preliminary tests (p 85) . . . And output is still declining but is 16% above last year (p 87).

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Federal Power Commission may intervene in the fight over American Power & Light Co's proposed sale of Washington Water Power Co stock or assets to public utility districts. FPC Chairman Mon C. Wallgren last week wired WWP that the sale may involve transfer of FPC licenses and require prior commission approval. FPC is notifying other interested parties and requesting that it be informed of all relevant facts.

The Washington Senate last week passed the Gallagher Bill which would permit the city of Spokane to condemn Washington Water Power properties within the city if they are acquired by PUD's. Attached to the measure was an amendment requiring a favorable vote by the city before the PUD's could purchase. The bill was sent back to the lower house, which earlier let a separate measure similar to the purchase vote amendment die in committee.

The National Farmers Union has voted its Outstanding Service to Agriculture Award to Clyde T. Ellis, executive manager of the National Rural Electric Cooperative Association.

Generating capacity of central stations in the United States as of Feb. 1 was 69,102,310 kw. Steam stations accounted for 49,396,594 kw, internal combustion for 1,908,095 kw, and hydro for 17,797,621 kw.

It is estimated that in 1950 Boston Edison Co received nearly $1.5 million for energy sold to operate TV receivers.

Notes From The News

One of the first uses of Seattle City Light's recently installed teletype system was to transmit the payroll from Skagit to Seattle when floods made mail delivery impossible. An advantage of the teletype as a means of communication is that it requires only 1/18th of a voice channel. City Light has ten between Seattle and Skagit . . . The Washington State Legislature has defeated a bill which would have financed construction of steam plants by the state. The bill, proposed by Gov. Arthur B. Langlie, would have imposed a license fee of ½% on power bills of all ultimate consumers of electricity in the state. Steam plants are sought to firm up water power . . . A 50-pound beaver held about 15 employees of Union Electric Co's Ashley (Mo.) Steam Plant at bay for almost an hour last week. The men jumped on tables and desks when the beaver stalked into the plant's office. The animal finally was captured by humane society officers and set free in the Mississippi River . . . The Army Engineers will resume work on Furman Shoals Dam, halted 22 years ago. The dam, which was half completed in 1928, will supply middle Georgia with power . . . Governor Stevenson of Illinois has asked Union Electric Co to postpone an April 1 eviction date for 325 families residing on land bought by the utility. The governor asked that the families, living in Venice, be given six months to a year to find new homes . . . Ohio Edison Co is entering the last stages of a $200,000 program to rid the downtown area of Akron of overhead wiring. By next year most of the overhead wires will have gone underground . . . With the kite season approaching Pacific Gas & Electric Co has issued a comic book, "Having Fun with Kites," to teach children kite safety rules. The books are being circulated at schools and city recreation departments.

Industry Mobilization—An Explanation

The two words at the top left of this page mark the beginning of another "Electrical World" department. On this page (and pages following if necessary) the editors will concentrate all of the news of industry mobilization which in previous issues has been scattered throughout the book. Every effort will be made to cover accurately, promptly, and simply the activities of the Defense Electric Power Administration, the Power Equipment Division of the National Production Authority, and any other mobilization agencies affecting the industry. The stories in this department will be written by EW's editorial staff. They in turn will rely heavily for background and information as well as stories on the Washington Bureau of the McGraw-Hill Publishing Co. This is the largest trade news bureau in the capital. And because in this era of defense mobilization Washington news is leading news, EW's new department will lead the news section each week.

PED Gets Power to Cancel, Change, or Transfer Orders for Equipment

National Production Authority last week put some teeth in the operation of its Power Equipment Division.

NPA's order M-44, issued March 5, requires heavy power equipment makers to submit order board information on form NPAF-31 (EW, Feb. 26, p 64) not later than the fifteenth of each month. First mandatory filing of the reports is due March 15.

NPA, through PED, may:

1. "Direct the return or cancellation of any order on the books of a manufacturer."

2. "Direct changes in the production or delivery schedules of a manufacturer, requiring him to fill orders in such sequence as it may determine."

3. "Allocate orders placed with any manufacturer to another manufacturer or manufacturers."

4. "Take such other action as it deems necessary concerning the placing of orders for power equipment or parts thereof or concerning the production or delivery of power equipment or parts thereof."

Beginning March 16 a manufacturer "shall produce, ship or deliver power equipment only in accordance with his most recent schedule," as approved or modified by NPA.

Unless NPA "shall have specifically advised the manufacturer to the contrary," his production and delivery schedules are to be considered approved within 14 days of the date of mailing (as shown by the postmark) by manufacturers.

Only exemption granted from the new rule is for orders for equipment or parts "having an aggregate fabricated value of $5,000 or less."

When a manufacturer finds that it will be impossible or impracticable to maintain production or delivery in accordance with his approved schedule, he must report it to NPA, with an explanation. NPA may be able to help get materials or other assistance in such cases.

If a manufacturer seeks an adjustment or exception to any provisions of the order, he should write to NPA detailing all pertinent facts, the relief he wants, and his justification for it.

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NSRB Sets Filing Date for Necessity Certificates

Applications for necessity certificates to qualify for accelerated amortization under the Defense Production Act must be filed with the National Security Resources Board on or before March 23 for "facilities upon which construction, reconstruction, erection, or installation was begun or which were acquired on or before Sept. 23, 1950."

In the case of electric utilities, NSRB will refer the applications to the Defense Electric Power Administration. Applications must be made on form NSRB-140, which can be secured from the National Security Resources Board, Washington 25, D. C.

Depa Plans to Spell Out MRO Order for Utilities

National Production Authority's maintenance, repair and operation order (EW, March 5, p 13) applies to electric utilities, but how is another matter.

Fuel Costs Excluded

Defense Electric Power Administration last week mailed copies of the order to utilities with a letter noting one exception. Electric utilities were advised not to include fuel costs under MRO in computing base period expenditures. In the usual manufacturing operation, fuel costs would be MRO, but the utilities' fuel is more nearly comparable to the manufacturers' production material.

This, however, is only one of many objections that electric utilities will find in the regulation. There are countless complications in making the order jibe with the carefully prescribed accounting procedures set up by regulatory bodies for the utilities. For example, Federal Power Commission units of property for fixed capital accounting contain many MRO items.

Supplement Being Prepared

Depa is working on a supplemental order to the NPA regulation which will spell out in more workable terms how the MRO rules can be applied to electric utilities. This order must be approved and issued by NPA.

The proposed order, however, will not take care of some difficulties. It cannot amend the sections which permit capital additions of $750 or less to be included in MRO but do not permit them to be charged against the MRO base or in any other way alter the basic regulation.

The electric utilities could draw some small measure of comfort from the fact that other industries were complaining, too.

NPA when it issued the regulation said it would not work for transportation and mining. Textile machinery makers and other expanding industries have told NPA that the base period system is all wrong for their requirements. How much help these industries will get is going to depend on how far supplies of steel and other metals can be stretched between now and July 1, when the Controlled Materials Plan takes over.

INDUSTRY MOBILIZATION

Chapman Overrules Depa Advisers, Favors Northwest Aluminum Plants

Interior Secretary Oscar L. Chapman has overruled some of his private power industry advisers. He will press for expansion of electric energy-using industry—notably aluminum—in the power-short Northwest.

Chapman's new policy was spelled out March 1 in two memoranda to his Depa administrator, Clifford B. McManus. Immediate effect was expected to be the early signing up of the Aluminum Co of America for a new plant at a dam in Washington. But the policies established by Chapman may have far-reaching implications for regional development as well as important implications in the federal-private power fight in the Northwest.

Median-Water Standard Set

In his "Power for Defense Industries" memorandum, Chapman told McManus that: "In planning the expansion of defense industries, the location of which is dependent upon power supplies, it will be our basic assumption during the emergency period and until new capacity can be added that median or probable water conditions shall be used to determine the power resources available for new industrial expansion." Also to be considered in locating new high-power-load plants are power plants under construction.

This was Chapman's answer to private power officials now serving under McManus in the Defense Electric Power Administration and other private power spokesmen, who have argued that there isn't enough power to support aluminum expansion on the Columbia. It flies in the face of an unwritten rule that firm power supply estimates for hydro developments should be based on the lowest water year of record or at least a poor year.

Chapman Favors Calculated Risk

Chapman said the region has had median or better water in 20 of the past 26 years. "I am justified in assuming a calculated risk on power supply in the Pacific Northwest by approving expansion of defense industries based on power supplies available during the next few years under median-year water conditions."

Ironically, the dispute that led to Chapman's decision arose over a dam owned by a private electric utility, Puget Sound Power & Light Co. Puget's Rock Island Dam, near Wenatchee, Wash., has 60,000 kw installed, but has space for adding another 150,000 kw. Use of the undeveloped power at Rock Island for aluminum expansion was broached last fall by Depa when it was headed by an acting administrator from the area, D. L. Marlett, assistant BPA administrator.

Private Group Opposes Northwest

Private power leaders on Depa's staff were less than enthusiastic about the idea. They pointed out the Northwest could absorb the added 150,000 kw and a good deal more as it became available. Other government officials were said to oppose aluminum expansion on the Columbia because that region is potentially accessible to attack from Soviet Asia.

Alcoa, however, was interested by the prospect of more cheap hydro power, and Interior's power planners urged the development of Rock Island.

The Rock Island project bogged down at first because Puget was not able to undertake the $25-million project. Then, Chelan County (Wash.) Public Utility District, which is likely to take possession of the dam under condemnation proceedings, agreed to lease the "holes" in the plant and install the units. The lease provided that the PUD will resell energy which it doesn't use on its own system to Puget, so it can offer power to Alcoa.

Alcoa Negotiates with Chelan

Alcoa has been negotiating with the Chelan County PUD for 120,000 kw of new power at Rock Island Dam. A design contract has been let by the PUD for adding six generators to this project, providing for an additional output of 135,000 kw.

Alcoa also is negotiating with BPA for an added 60,000 kw of interruptible power, thus providing 180,000 kw for its proposed plant.

BPA has made contingent power reservations of 120,000 kw of firm and interruptible power for the proposed Eastern Metal Products plant at an unannounced "tide-water location on the Columbia River." This company will operate as the Troy Aluminum Co. Its president is Arnold Troy, Tuckahoe, N. Y.

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Industry M Orders

The following M orders of interest to the electrical industry have been issued by the National Production Authority. Orders not of interest have been omitted. Copies of orders may be secured from the National Production Authority, Washington 25, D. C., or any regional office of the Department of Commerce.

M-20—Iron and Steel Scrap: Establishes inventory limitations for iron and steel scrap and subjects such scrap to allocation to ensure its distribution in the interest of national defense—as amended.

M-22—Aluminum: Regulates the segregation, acceptance, delivery, and distribution (whether on purchase, toll agreement, or otherwise) of aluminum scrap. Prohibits undue accumulations of such scrap—as amended.

M-24—Tin plate and terne plate: Lists permitted uses.

M-30—Tungsten: Prohibits use in listed products, establishes limitations on additions to inventory, and makes tungsten subject to allocation. Prohibits deliveries of tungsten not specifically allocated by NPA.

M-37—Zinc Scrap: Regulates the acceptance, delivery, and distribution (whether on purchase, toll agreement, or otherwise) of zinc scrap. Prohibits undue accumulations of such scrap.

M-38—Lead: Limits inventories of lead and materials containing lead, other than ores and concentrates. Explains conditions under which reports are required in connection with production, receipt, shipment, use, and inventories of lead and materials containing lead.

M-39—Antimony: Same as M-38 with "antimony" substituted for "lead."

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Control of Lamps Studied

Electric lamps, both fluorescent and incandescent, may go under rigid government control all the way from raw materials to shipment of the final product. Shortage of tungsten and molybdenum led the National Production Authority to appoint an industry task force to study the effects of such an order.

Power for Peace Ready for Defense

Consumers Power Co of Michigan Has Dual-Purpose Construction Program; New Plant Will Serve Rising Demand and War Industries

Consumers Power Co is more than prepared to supply the power for the nation's World War II "arsenal of democracy"—the state of Michigan. This company's service area covers in whole or in part 56 of the 68 counties in the Lower Peninsula of Michigan, embracing in all approximately 28,000 sq miles. In this area are located most of Michigan's principal industrial centers aside from metropolitan Detroit. Consumers is ready to meet the mobilization call of these industries with power "designed for peace—but ready for defense."

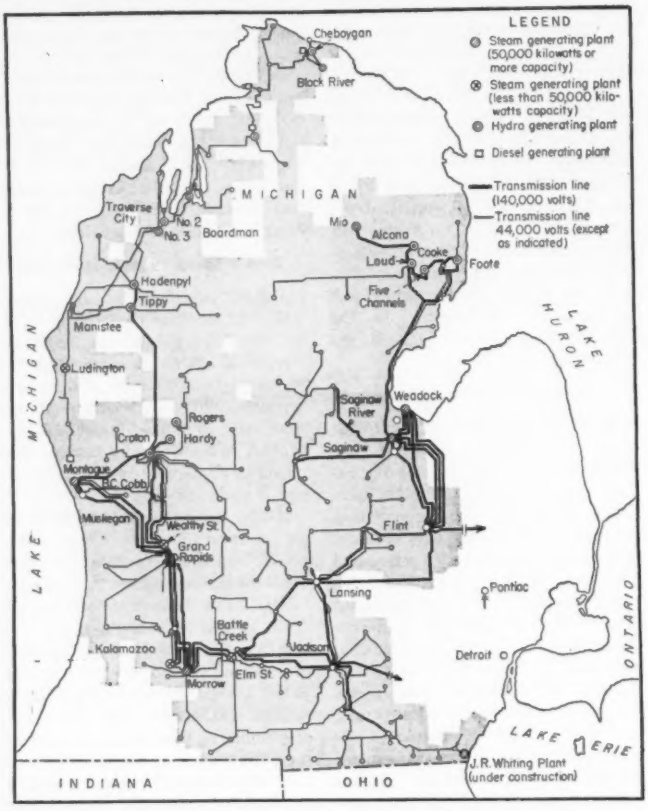
Independent Since 1949

Consumers became an independent operating company in 1949. Prior to that the Commonwealth & Southern Corp owned 88% of the outstanding common stock. On Sept. 30, 1949, in accordance with a plan of dissolution approved by the Securities and Exchange Commission, Commonwealth delivered its shares of common stock in Consumers to an agent for distribution to the preferred stockholders of Commonwealth.

A $218-million construction program between 1946 and 1951 is part of a long-range plan extending into 1954. It will provide an increase of more than 100% in generating capacity since 1945. The 1951 construction budget, aggregating $48 million for all services, is the largest in the company's history. Expenditures in 1950 amounted to $42 million.

Whiting Plant Under Construction

Principal current construction project is the 276,000-kw Justin R. Whiting Plant on Lake Erie, named in honor of the president of Consumers. The first two units each with a capacity of 85,000 kw are scheduled for initial operation in 1952. A 106,000-kw unit will be installed at a later date. Completion of this project will give Consumers an increase of 680,000 kw in capacity since 1945 and will bring its state-wide interconnected system to a total capacity exceeding 1,350,000 kw. Present capacity of the system is 1,074,745 kw.



CONSUMERS POWER CO territory includes all of shaded area on map

In addition, the company maintains two interconnections with Detroit Edison Co's system near Jackson and Flint which account for another 200,000 kw. These interconnections provide for parallel operation of the two electric systems and permit the staggering of inspection, repair, and construction of generating units by the two companies. Consumer's 3,900-mile integrated transmission system ranges from 22 kv to 140 kv.

As part of the 1950 construction program, 951 miles of transmission and distribution lines were added to the system. The completion of 42 substations and the enlargement of others accounted for a total additional capacity of 325,000 kw.

Consumers Power is the largest utility in the United States not serving a metropolitan area. The diversity of area represented by its 1,300 communities presents a parallel diversity of industrial operations. From the standpoint of ability to provide facilities for industrial defense production, the company's area stands out in the national picture. Michigan's population has increased by more than 1 million in the past ten years, and to a large extent this growth has occurred

in territories being served by Consumers.

Electrical development has been rapid in this area, both in urban and rural territory. Average residential consumption has doubled in the past 12 years and reached 2,361 kwhr per customer in 1950. Electrification of rural areas is essentially complete in the matter of availability of service, and it is believed that this also has a bearing on the ability of industry to decentralize by establishing production units in smaller communities. Consumers serves more than 105,000 farms, the largest number served by any utility company in the country.

Significance is attached to records set in 1950 as a part of the company's routine operations. These records serve to indicate its ability to supply power for any industry defense requirements. This is viewed as particularly important when measured by the maximum requirements of industry in World War II when many plants were operating on a 24-hour basis with six and seven-day work weeks. Consumers emphasizes the fact that the element of load factor with respect to longer-hours use of existing industrial facilities has an important bearing on the ability to supply the electrical requirements for greatly increased unit production in industry. This is particularly true in a generating system such as Consumers Power where more than 86% of the capacity is in steam.

The maximum day's sendout of power in 1950 occurred in December —18,432,000 kwhr. This is 78% greater than the greatest one-day sendout at any time during World War II. The 1950 maximum hour peak load was also reached in December—972,-605 kw.

Electric sales for 1950 exceeded 4.5 billion kwhr, an increase of 17% over 1949. Electric revenues amounted to $85,573,000. Consumers serves 675,-800 customers in all.

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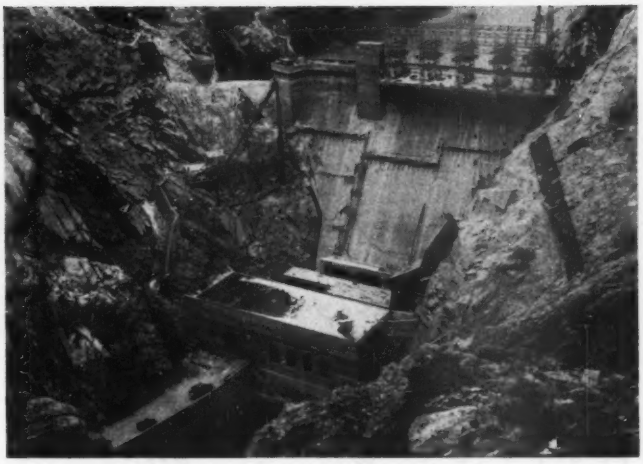
120,000-Kw Plant Planned

Illinois Power Co will start construction immediately on a 120,000-kw steam generating station at Hennepin on the Illinois River. The initial installation, scheduled for completion in 1953, will have a capacity of 60,000 kw.



THIRD AND LAST generating unit at the Kortes Dam project on the North Platte River, 60 miles southwest of Casper, Wyo., is virtually complete. Each unit has a capacity of 12,000 kw. Market area will be mainly in southeastern Wyoming

St. Lawrence Power Project Gets Strong Support at House Hearings

The St. Lawrence seaway and power project has received perhaps the strongest support in its long history in recent hearings before the House Public Works Committee. Steel company officials and a New York State spokesman joined with high government officials in urging favorable action on the project.

Maj Gen Lewis Pick, Chief of Army Engineers, estimated the U. S. power facilities would cost $129,493,-999. Mon C. Wallgren, Federal Power Commission chairman, told the committee St. Lawrence power could be delivered at points as far as 300 miles away at less than half the cost of steam generated power. Wallgren reported FPC estimates that the 940,500-kw installation would produce 6.3-billion kwhr a year.

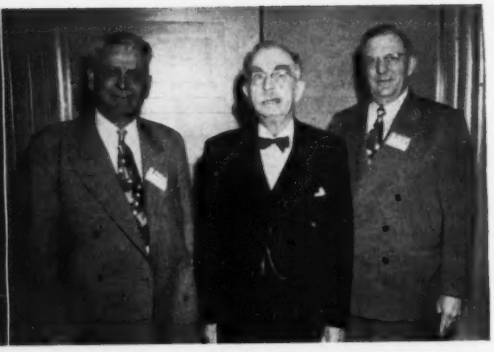
Here are some of the statements heard by the committee on legislation which would approve a 1941 agreement with Canada, authorize construction of the project, and provide for transfer of U. S. power facilities to New York State:

Defense Mobilizer Charles E. Wilson—"We need the seaway, and we need the power, too, both for the special needs of defense and for our economic strength over the long pull."

Commerce Secretary Charles E. Sawyer—"The solid commercial basis of the project is but the reflection of its immense economic advantages. These are so great, and the investment is so modest in comparison that not only can we afford to build the project, we literally cannot afford not to build it, exclamation point."

John E. Burton, chairman, Power Authority of the State of New York —"The Power Authority of the State of New York offers to join into full partnership with the federal government to finance, construct and operate the power side of the St. Lawrence dual-purpose project from the very beginning. We would expect to do this in complete cooperation and joint supervision with the Federal Power Commission and the Army Engineers."

Interior Secretary Oscar L. Chapman—"Harnessing the energy of the St. Lawrence would enable the New York-New England region to make a far larger contribution to the national defense effort and would greatly strengthen the economic fabric of the country as a whole."



CARL JENSEN, (left) Westinghouse Lamp Division, pauses at the North Central Electrical Industries convention to speak with George Spurbeck, Minnesota Power & Light Co, and A. B. Halloway, Illuminating Engineering Society. Right Panel, P. J. E. Peterson, vice president, and Harry Edmunds, president, both of the Minnesota Electric Cooperative, pose with A. C. Weihe, president, Municipal Utility Association. Spurbeck showed the convention how school lighting can be sold

Maintain Sales Promotion Efforts, North Central Industries Advised

Sales, public relations, and general economic problems, particularly those concerned with mobilization and present world conditions, were discussed at the annual convention of North Central Electrical Industries held in Minneapolis, Feb. 25-28.

Following the theme "Crisis In Confidence," W. H. Robinson, Jr, of General Electric Co, remarked that while we are listening to many cries of crisis, the greatest crisis we face is the crisis in confidence. He cited the virtual rebirth of American industry in the past 10 years, which has brought the economy to $300 billion a year, and said we can afford to set aside vast sums for armament. He pointed out that we are not starting from scratch this time but have more men, materials, and plants available than in 1941; and if we "roll up our sleeves and go to work," we shall in the predictable future, perhaps in 1953, be able to revert to an economy of peace.

Carl Bremicker, vice president, Northern States Power Co, speaking at the North Central Electric Association's sales conference, held in conjunction with the NCEI convention, said that the public power grid is extending itself. As important factors in this process he cited the discriminatory "preference customer" clause in the federal power law and the "continuing funds" which permit heads of government agencies to write checks without authorization from Congress.

H. W. Bennett, General Electric, told the convention that his company has been teaching employees how the American business system operates. Employees are told how this system provides the highest standard of living the world has ever known.

In the all industry lighting conference, Carl Jensen of Westinghouse Electric Corp's Lamp Division demonstrated the possibilities of sharp increases in illumination in industrial plants for small increases in cost through maintenance and cleaning of lamps, fixtures, and paint.

George Spurbeck, lighting sales manager, Minnesota Power & Light Co, showed how to sell school light-

C. G. WRIGHT, (left) vice president, Otter Tail Power Co, and W. H. Robinson, Jr, General Electric Lamp Department, stand with E. K. Thorgaard, president, North Central Electric Association, and Carl Bremicker, vice president, Northern States Power Co, after the banquet of the North Central Electrical Industries convention. Right panel, Gordon Tucker, Mid-Western Electric Council, chats with Frances Armin, National Adequate Wiring Bureau; John Lapham, North Central Electric Association; and Harold H. Beaty, Edison Electric Institute. Robinson was a speaker at the banquet meeting

ing by demonstrating to school boards and parent-teacher groups the ease with which they can read school books under good lighting and the difficulty they have under poor lighting conditions. The demonstration used is a box with flood lights that can be turned on or off one at a time to give different light intensities.

L. E. Johnson, Northern States Power Co, showed how to sell the cost of planned lighting by breaking that cost down into per cent of payroll, comparing present costs of good lighting with costs of poor lighting years ago. These costs are then looked at in terms of increased efficiency and what that means with present high wages and labor rates.

On an interesting color slide tour of upper Midwest lighting installations, H. S. Walker, General Electric, showed more than a hundred slides of outstanding installations in the area.

Miss Jan Reynolds, Sylvania Electric Products Corp, with color slides, illustrated what can be done with lighting in the home.

In the NCEA sales conference, programs for 1951 were discussed. Most of these parallel the programs carried on during 1950 with budgets the same or slightly higher. The theme, expressed by one speaker and generally agreed to by all, was that sales, promotional, and customer contact activities should be maintained and that, war or no war, merchandise or no merchandise, every effort should be continued to "keep customers drooling" for service.

At the rural electric equipment meeting, the theme was "service and information" to the farmer and the farm family to help them make better use of their electrical equipment. Dr. Andrew Hustrulid of the University of Minnesota, pointed out that private utilities, universities, manufacturers, and users do research on electrical equipment and that it is important that accurate information and more of it should be made available to the farmer.

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Orders 40,000-Kw Unit

The Board of Water and Electric Light Commissioners of Lansing, Mich. has ordered a 40,000-kw turbine-generator and boiler for its Moores Park Station. Delivery is promised for 1953.

MODEL POLE LINE is used by Consumers Power Co at Battle Creek, Mich., to acquaint groundmen, linemen, foremen, and certain engineering personnel with the correct answers to true-false quizzes being held throughout the company. Line consists of seven poles equipped with three transformers and a complete primary and secondary wire line. Transformers, rated 120-120/240 v, are placed in one-gallon tomato cans. Each transformer feeds one span of secondary in each of two directions with secondary jumpers at the "null" points. Secondary wires can be short-circuited to blow primary fuses. Other field conditions can be simulated.

Advances in Control Room Parts Theme of PEA Equipment Group

Advances in the components that constitute the functional parts of the control room were the theme of a two-day session of the Pennsylvania Electric Association Electrical Equipment Committee at Baltimore, March 1-2. Critical discussion focussed on the illumination, the panel instruments, the batteries, and the control cables.

In presenting the essence of the forthcoming IES report on control room lighting W. B. Morton, Pennsylvania Power & Light Co, ended with the statistics of the 47 cases recited in the report: 36 use fluorescent, 8 incandescent, and 3 a combination. Direct are 17, semi-direct 7, indirect 8, semi-indirect 1, louvered 6, solid plastic 1, combinations 7. Watts per square foot range from 1.45 to 13 with an average of 4.8.

Progress is being made in instruments despite the lack of uniformity in lighting techniques, said F. X. Lamb of Weston who strongly favored the 6-in. instrument. C. M. Rowell showed the new General Electric Co 4¼ and 8¾-in. instruments with domed glass, long scale, and 180-degree illumination. Wide angle readability is achieved by a dished dial in new Westinghouse Electric Corp line, said D. A. Young of that company.

Operators should be able to identify and read all instruments from the control desk, said James Nesmith, Public Service Electric & Gas Co, Newark, because of the increasing number placed on the panels. Some minor ones should be satisfactory if marked only quarter, half, and full load on the related motors. He added that the mechanical instruments are a headache because of their incongrous dimensions, and John Gue, Duquesne Light Co, concurred. J. B. Wray, Pennsylvania Water & Power Co, favored a minimum of distracting legends and front mounting with adjustment possible without removal.

Advantageous characteristics of the nickel-cadmium battery were cited by Carl Berg, Nickel Cadmium Battery Co, as inertness on open circuit, low water consumption, and avoidance of equalizing charges.

Considerable diversity was reflected in member company practices as to control cable; however, oil-base compounds and polyethylene were commonly mentioned along with neoprene jacketing. A compilation of data from 14 plants in seven states by D. R. Greene, Gilbert Associates, showed

about equal division between metal and Transite troughs with some cases comprising both materials. P. H. Robbins said the new Titus Station of Metropolitan Edison Co has over 222 miles of conductors in the control cables. H. A. Thompson, Duquesne Light Co, considers that control cables are much less a problem. The new mineral insulated cable of General Cable Corp was described and demonstrated by J. B. Clapp.

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Planned School Lighting Program Released by EEI

Edison Electric Institute and the Better Light Better Sight Bureau have released a new Planned School Lighting program for use by electric light and power companies and lighting equipment manufacturers.

The new school lighting program is the product of three years' experience and use of the original Planned School Lighting program by more than 100 electric utilities.

Among the materials offered are a large guide folder describing the sales and educational tools in the new program and three folders designed for public consumption, stressing the importance of good lighting in protecting children's eyesight. Also available are two booklets. One discusses basic classroom lighting ideas; the other illustrates the mechanical function of the eyes and the conditions that contribute to poor vision. In addition to these materials, mailing pieces have been prepared.

Further information on the program including price lists may be obtained from the Edison Electric Institute, 420 Lexington Ave, New York 17, N. Y.

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Chapman Denied Appeal in Roanoke Rapids Case

Federal Power Commission has affirmed its licensing of Virginia Electric & Power Co to develop a hydroelectric project at Roanoke Rapids by denying Interior Secretary Oscar L. Chapman's petition for a rehearing.

Also denied Feb. 27 was a similar petition for rehearing filed by the Virginia REA Association. As interveners, Interior or the REA may now challenge the decision in the courts, action hinted at by counsel for the secretary during hearings in the case.

Arizona Power Authority Becomes Operating Agency, Sells U. S. Energy

The Arizona Power Authority now is in business with the start of delivery of Davis Dam power. Transmission is over a $13-million line running 412 miles from the Colorado River dam to Southern Arizona.

This marks fulfillment of seven years of work by the authority to obtain construction of the 230-kv line as part of the $114-million dam and transmission project.

The authority is a state agency set up to distribute Colorado River power over a statewide grid. It has obtained 316,000 kw for Arizona from Hoover and Davis Dams.

Public agencies have contracted for 51.5% of the energy. The rest goes to private utilities. A basic charge of 75¢ per kw per month is charged by the authority. The rate diminishes on a demand and energy ratio. For the first 250 hours' use, the rate is 3.5 mills per kwhr. All over that is at the rate of 3 mills per kwhr.

Public agencies serviced by the authority include co-ops, power districts, and municipalities. Private subscribers include Arizona Edison Co, Central Arizona Light & Power Co, Northern Arizona Light & Power Co, Tucson Gas, Electric Light & Power Co, and Eloy Electric & Power Co.

The authority receives power and handles its resale on a nonprofit basis. It has constructed no transmission lines but has arranged with the Bureau of Reclamation for use of bureau lines and will amortize the cost on the basis of kwhrs handled.

The lines were built with capacity to handle both bureau and authority demands. The authority has scheduled to 1987 amortization of its share of the facilities.

All transmission is handled by the Bureau of Reclamation with headquarters at the Aviola Building in Phoenix. Lines run between Hoover and Davis Dams and between Davis Dam and Coolidge in south central Arizona.

From the Collidge substation, power is transmitted to central and southeastern Arizona supplementing energy coming into the Phoenix area over two 161-kv lines.

Early in 1952, the system will carry the output of two 82,500-kva generators being installed for Arizona use at Hoover Dam.

These units are under government title, but the Arizona Power Authority has underwritten their expense, amortizing the cost to 1987.

The authority was set up in 1944 with a $100,000 loan from the state and subsequently was allotted another $150,000 to continue its work. It has been largely under the guidance of Michael J. Doherty, who drafted the Power Authority Act.

LAST COMMUNITY in Massachusetts to receive electricity is the tiny Indian village of Gay Head on Martha's Vineyard. Linemen of the Cape & Vineyard Electric Co recently completed lines into the village of 88, famous as an old whaling settlement and summer resort

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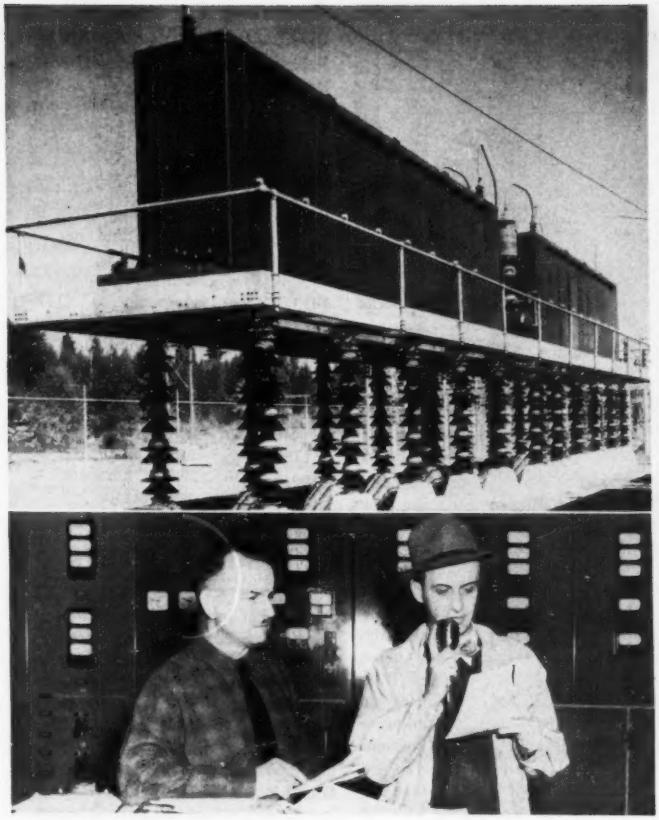
To Add 2 Reheat Units

Public Service Electric & Gas Co, Newark, plans to install two 145,000-kw turbogenerators at its Kearny generating station. Both units will generate power at 20 kv and will be designed for steam at 2,350 psig, 1,100 F/ 1,050 F reheat. Each will have a 950,000 lb per hr steam generator with forced circulation, designed to burn pulverized coal, oil, or natural gas. The additions will raise station capacity to 624,000 kw.



SERIES CAPACITORS on the Bonneville Power Administration system have a present rating of 230 kv, 15,000 kvar, 3 phase. Shown above are two capacitor housings per phase, together with the air blast protective gap, mounted on insulator columns. Shown below are Cliff Diemond, right, BPA relay engineering chief, who directed recent tests on the series capacitor. He was assisted by Eugene Starr, BPA consultant and professor of electrical engineering at Oregon State College, Corvallis

BPA Series Capacitors Pass Preliminary Tests

Preliminary short-circuit tests, carried out on relaying and protective equipment of Bonneville Power Administration's new 230-kv series capacitor installation near Chehalis, Wash., indicate that the unit can be bypassed in the event of a line fault without creating serious system disturbances. Beginning shortly before 1:45 AM and continuing into the late afternoon of Feb. 25, eight fault tests were made, during which the 230-kv line between Covington substation and Chehalis was faulted.

Tests were witnessed by about 75 engineers, including Cliff Diemond, BPA relay engineering chief and R. E. Marbury, Westinghouse Electric Corp. Others present were W. A. Morris, Bureau of Reclamation; Orin A. Demuth, BPA; and J. R. Robert, Electricite de France, Paris.

Unlike 230-kv, series-capacitor installations in Sweden, the BPA unit is designed for instantaneous reinsertion following line disturbances. If the installation proves out satisfactorily under further testing, BPA will install two other units in the 300-mile Northwest Power Loop between Grand Coulee and Portland and Seattle. An official of BPA pointed out that on a 300-mile, 230-kv line, under optimum conditions of load, the $250,000 test-type capacitor will increase the line capacity by 65,000 kw to a total of 185,000 kw. Two units are also contemplated on the proposed intertie between the California Central Valley project and the Bonneville system.

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WRPC Plan Will Control Power Supply, Says EEI

A program which "would eventually establish complete national government control or ownership of all water and land, as well as electric power supply of the nation" is the plan that emerges from the first report of the President's Water Resources Policy Commission. This is the analysis made by H. S. Bennion, managing director of Edison Electric Institute.

Commenting on the first of the report's three volumes, he said, "Let this point be clear: The scope of the program outlined in the commission's report far exceeds the question of injecting the federal government into the power business. The real question at issue is whether . . . the American people would grow and develop better under a system that depends to a maximum degree on self and local government and individual initiative, resourcefulness and responsibility, or whether they would develop better under a national socialist government."

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PUD Given Preliminary Permit for Hydro Project

The Federal Power Commission has granted a six-month preliminary permit to Public Utility District No. 1, Pend Oreille County, Wash., for a proposed hydroelectric project in Box Canyon on the Pend Oreille River in Washington State.

The proposed project would have an installed capacity of 60,000 kw.

Under terms of the preliminary permit, the PUD must file an application for an FPC license within six months, if it proposes to construct the project.

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B. C. Commission Moves

British Columbia Power Commission has moved its headquarters into a new four-story commission building in Victoria, B. C. The building is on the triangle contained by Burdette, Blanshard and McClure Streets. A staff of 75 persons was involved in the move.

YIELDS (%) — Operating Electric Utility Securities

Quality	Bonds			Preferred Stocks			Common Stocks		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE									
1950									
Feb. 28	2.70	2.72	2.80	3.81	4.01	4.46	5.41	6.09	6.81
Feb. 21	2.68	2.70	2.78	3.80	4.00	4.46	5.52	6.13	6.90
END OF QTR									
4th 1950	2.65	2.67	2.78	3.86	4.14	4.51	5.80	6.54	7.44
3rd 1950	2.66	2.67	2.76	3.81	4.08	4.46	5.70	6.54	7.25
2nd 1950	2.68	2.66	2.74	3.79	4.03	4.38	5.38	6.51	7.50
1st 1950	2.59	2.61	2.74	3.78	4.01	4.36	5.22	5.85	6.67

Data: Reis & Chandler, Inc.

Manitoba to Expropriate Winnipeg Electric Co

The provincial government of Manitoba intends to expropriate the $92-million Winnipeg Electric Co. Premier Douglas Campbell said a bill will be introduced soon in the legislature for purchase of the utility's assets.

The announcement culminated a long dispute among the province, the utility, and the city of Winnipeg. The city will be allowed "at least for the time being" to retain its municipally owned City Hydro, and its purchase of Winnipeg's electrical distributing, transportation, and gas facilities will be "facilitated" by the province. The utility also operates the transit system in Winnipeg.

The city will be required to join a power pool administered by a provincial hydroelectric board. The latter's aim will be to equalize the cost of energy to consumers by pooling high-cost and low-cost power.

Winnipeg Electric developed the best sites on the Winnipeg River at a time when costs were low, and it has been able to supply cheap power. At one time its rates were the lowest in North America. The provincial government has been developing higher-cost sites, most recently a $20-million station at Pine Falls 65 miles northeast of Winnipeg.

Under the proposed setup the government will control all generating facilities except City Hydro's two plants. There will be two distributing agencies—City Hydro for Winnipeg and the Manitoba Power Commission for the rest of the province. The proposal is a modification of the plan recommended by a commission appointed to study the power situation.

Winnipeg Electric had gross assets of $91,950,000 as of Dec. 31 and a funded debt of $28,800,000. Its annual dividend rate recently was raised from $1.40 to $2.

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Compromise Agreement Averts Strike in Seattle

A threatened power strike (EW, March 5, p 20) was averted in time for Seattle City Light to take over local properties of Puget Sound Power & Light Co without incident.

The walkout, scheduled for March 4, was called off when Local 77 of the International Brotherhood of Electrical Workers, AFL, accepted a city-sponsored compromise. The union had demanded a signed contract from the city council but settled for an arrangement that will permit unions to negotiate wage and working conditions with the lighting superintendent.

The superintendent rather than the council will sign agreements with the union, but they must be ratified by the council before being embodied in the annual budget and salary ordinances. The agreement also provides that "all questions of union jurisdiction shall be settled by the unions involved" and that "all unions with members in City Light shall have the right to confer and negotiate with the management."

The compromise saves face for both the council, which had argued that municipal policy did not enable it to sign union contracts, and the union, which had insisted it would strike unless it got the contract.

Operating Revenues Up 12.3% During November

Electric operating revenues of the larger privately owned electric utilities in the United States in November were 12.3% above those of the same month the year before, the Federal Power Commission reports.

Revenue deductions were 14% over those of November, 1949; gross income increased 4.8%; and net income 5.1%.

November revenues amounted to $413,007,000, compared to $367,747,000 in November, 1949. Revenue deductions (including operating expenses, depreciation, and taxes) were $331,354,000 for the month.

Gross income, including other utility operating income, totaled $88,832,000 in November, 1950. Net income was $65,523,000, compared to $62,371,000 the year before.

FINANCIAL BRIEFS

Pyallup has joined the list of western Washington cities that are attempting municipal ownership of their electrical distribution systems rather than give way to public utility district ownership. The city will vote March 13 on authorization of a $1.6-million bond issue to purchase the local system of Puget Sound Power & Light Co. The issue lost in a previous election. The city council put the measure on the ballot again as a result of a recent state supreme court decision upholding the right of a PUD to condemn power facilities without voters' approval.

Washington's Supreme Court has refused to reconsider its decision upholding constitutionality of the controversial 1949 power act, which permits two or more public utility districts to join to acquire properties of a privately owned public utility system. PUD's now are negotiating for purchase of Puget Power properties.

Electric Utility Financing—February 24-March 3

Company	Description	Amount of Offering (000)	Offering Price	Yield at Price to Public
Bonds				
Consolidated Edison of NY	3% 1981 new money	$60,000	101.994%	2.90%

SCHEDULED FOR FOLLOWING WEEK

Bonds—Lake Superior District Power, 1981 new money, $2 million.

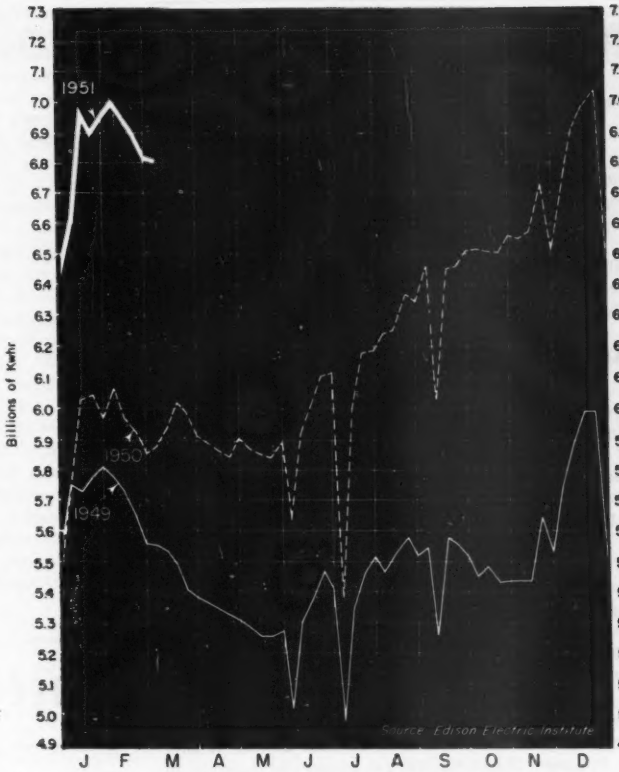
Preferred Stock—Virginia Electric & Power, 100,000 sh $100 par new money, $10 million.

Common Stock—West Penn Electric, 320,000 sh new money, $8.5 million.

Hells Canyon Dam Would Triple Output Potential

The proposed $357,000,000 Hells Canyon Dam on Snake River on the Idaho-Oregon border would make available nearly three times as much hydroelectric power as five low run-of-the-river plants proposed by Idaho Power Co, at a lower cost per prime kilowatt, according to H. T. Nelson, regional director for the Bureau of Reclamation.

Of 1,400,000 kw of prime power which would be added to the Northwest power supply by the project, 688,000 kw would be generated at Hells Canyon Dam. An additional 712,000 kw would be available at downstream federal plants through which 4,400,000 acre-ft of storage water released from behind the proposed dam would pass and at other federal power plants interconnected with Hells Canyon plant. Five low dams, without storage, would generate an estimated 487,000 kw, Nelson said.



Output Week Ended March 3—6,822,098,000 Kwhr

Weekly Output, Millions Kwhr

1951		1950		1949	
Mar 3	6,822	Mar 4	5,879	Mar 5	5,552
Feb 24	6,833	Feb 25	5,854	Feb 26	5,559
Feb 17	6,905	Feb 18	5,931	Feb 19	5,650
Feb 10	6,957	Feb 11	5,971	Feb 12	5,722
Feb 3	7,099	Feb 4	6,062	Feb 5	5,778
Jan 27	6,970	Jan 28	5,972	Jan 29	5,810
Jan 20	6,909	Jan 21	6,041	Jan 22	5,769
Jan 13	6,981	Jan 14	6,029	Jan 15	5,727
Jan 6	6,602	Jan 7	5,695	Jan 8	5,742
1950		1949			
Dec 30	6,479	Dec 31	5,493	Jan 1	5,562

Percent Change from Previous Year

	Mar 3	Feb 24	Feb 17
New England	+ 8.8	+11.6	+13.3
Mid-Atlantic	+11.8	+13.9	+14.5
Central Industrial	+21.2	+17.1	+18.4
West Central	+13.7	+15.7	+16.3
Southeast	+11.9	+16.0	+18.4
South Central	+23.6	+23.4	+20.7
Rocky Mountain	+12.6	+19.5	+10.4
Pacific Coast	+19.7	+19.7	+14.3
Total United States	+16.0	+16.7	+16.4

MEETINGS

Interstate Power Club of New York
Hotel Martinique, New York City, March 12.

National Electrical Manufacturers Association
Annual Meeting, Edgewater Beach Hotel, Chicago, Ill., March 12-15.

National Association of Corrosion Engineers
Conference and Exhibition, Hotel Statler, New York, March 13-16.

Protective Relay Engineers
Annual Conference, Agricultural & Mechanical College of Texas, College Station, Texas, March 26-28.

Oklahoma Utilities Association
Annual Convention, Mayo Hotel, Tulsa, Oklahoma, March 29-30.

Southeastern Electric Exchange
Engineering and Operation Section, Vinoy Park Hotel, St. Petersburg, Fla., March 29-30; Annual Conference, Boca Raton, Fla., April 11-13.

★Edison Electric Institute
Annual Sales Conference, Edgewater Beach Hotel, Chicago, April 2-5; Purchasing and Stores Committee Annual Conference, Lord Baltimore Hotel, Baltimore, Md., April 30-May 2; Transmission and Distribution Committee, Edgewater Beach Hotel, Chicago, May 1-2; Meter and Service Committee, jointly with Association of Edison Illuminating Companies' Committee on Metering and Service Methods, Huntington Hotel, Pasadena, Calif., May 7-9; Commercial Electric Cooking Conference, Sheraton Hotel, Chicago, Ill., May 9; Electrical Equipment Committee, Hotel Biltmore, Los Angeles, Calif., May 28-29; Annual Convention, Shirley Savoy Hotel, Cosmopolitan Hotel, Denver, Colo., June 4-7.

American Society of Mechanical Engineers
Spring Meeting, Atlanta Biltmore Hotel, Atlanta, Ga., April 2-5; Semi-Annual Meeting, Royal York Hotel, Toronto, Canada, June 11-15.

Electric Association of Chicago
Industrial Electrical Exposition, Sherman Hotel, Chicago, Ill., April 3-6.

Midwest Power Conference
Sherman Hotel, Chicago, April 4-6.

Missouri Valley Electric Association
Engineering Conference, President Hotel, Kansas City, Mo., April 4-6; Accounting Conference, President Hotel, Kansas City, Mo., May 17-18.

Indiana Electric Association
Young Men's Utility Conference, Ipalco Hall, Indianapolis, April 10-11.

American Institute of Electrical Engineers
District No. 4 Meeting, McFadden-Deauville Hotel, Miami, Fla., April 11-13; District No. 1 Meeting, Hotel Syracuse, Syracuse, N. Y., May 2-4; District No. 5 Meeting, Loraine Hotel, Madison, Wis., May 17-19; Summer General Meeting, Royal York Hotel, Toronto, Canada, June 25-29.

Northwest Public Power Association
Annual Convention, Cascadian Hotel, Wenatchee, Wash., April 12-14.

Rocky Mountain Electrical League
Annual Spring Conference, Shirley Savoy Hotel, Denver, Colo., April 15-18.

Northwest Electric Light & Power Association
Engineering Section, Hotel Utah, Salt Lake City, Utah, April 25-27; Business Development Section, Multnomah Hotel, Portland, Ore., May 7-9; Personnel Section, Davenport Hotel, Spokane, Wash., May 16-18.

★Pennsylvania Electric Association
Communications Committee, Bedford Springs Hotel, Bedford, Pa., May 3-4; Joint Meeting of Electrical Equipment, Transmission and Distribution Committees, Abraham Lincoln Hotel, Reading, Pa., May 10-11.

New Jersey Utilities Association
Spring Meeting, Seaview Country Club, Absecon, N. J., May 4.

American Public Power Association
Annual Convention, Read House, Chattanooga, Tenn., May 7-9.

★New York Society of Professional Engineers
Engineering Industries Exposition, Hotel Statler, New York, May 10-12.

Public Utilities Advertising Association
Annual Meeting, Hotel New Yorker, New York, May 17-19.

Missouri Association of Public Utilities
Annual Convention, Jefferson Hotel, St. Louis, Mo., May 21-23.

Pacific Coast Electrical Association
Annual Convention, Biltmore Hotel, Los Angeles, Calif., May 21-23.

★ Addition this week

WASHINGTON COMMENT

RONALD D. ROSS

The DO (Defense Order) priorities system may not survive the coming weeks. The system is shaky. If it topples, new faces will appear in some of Washington's high mobilization jobs.

Actually, the DO's need to work only until July 1, when they'll be superseded by the Controlled Materials Plan. But there are growing signs that the DO's, born last October, may not last even until CMP.

All with a DO Are Equal

The system provides but one priority. All DO orders are equal. At first, only the military and the Atomic Energy Commission could issue DO's for their orders. It even took several months to get DO's for portions of the Tennessee Valley Authority's steam plant construction program, even though it was geared directly to growing AEC power needs.

Meanwhile, non-DO orders were all equal, too. Makers of non-essential civilian goods battled in the market for scarce materials along with the makers of essential products—except that each manufacturer screamed that his product was "essential." The manufacturers of electric generating equipment had no priority over ashtray producers for scarce steel, copper, and aluminum.

It's estimated that roughly half of the potential production of generating equipment has been lost thus far in the year because of lack of essential metals. It adds up to some 700,000-900,000 kw, means that deliveries of new units may be two to five months late in beginning the second half of the year.

The answer, arriving months too late to save precious time in the expansion of electric generating capacity, was to grant DO's for the essential equipment. Approved in February, the new DO's won't help the equipment manufacturers until May. Nor is this an isolated case. Civilian aircraft production, and maintenance, repair, and operation supplies for almost all industry are now authorized for DO's. Petroleum, transportation, and other essential industries are clamoring for DO status.

"Certified Programs" May Be on the Way

There have been two breaks in the DO system. "Directives" are one-shot DO's to bring urgent deliveries and break more serious bottlenecks. "Certified programs" have been authorized for railroad equipment makers and ore boat production. They provide the equivalent of DO's for specified items or quantities of materials. This type of program is expected to be announced beginning April 1 for electric utilities, with Defense Electric Power Administration cutting the materials priority pie for the industry.

CMP, of course, looms as the best solution to the whole problem. It will not even give "essential" industries all the materials they need. A realistic CMP, however, can make tight supplies of critical materials go further in building up the nation for whatever may come. CMP is coming July 1.

Meanwhile, there's only one other real alternative to the DO, single-band priority system. That's a multiple-band system with different ranks of priority. It was tried early in World War II, and that experience is the reason why General Harrison and other mobilization policy makers have fought to preserve DO's. The last war's "A-1" to "A-10" priorities developed "AA's" and "AAA's", and pretty soon there were more priorities than there were materials.

A similar fate may meet the DO system. Under today's single priority plan, the only way to get needed materials to essential industry is to extend the DO's. There will be more and more authorizations to use DO's. At the same time, the military program is getting underway in earnest. Military DO orders will grow by leaps and bounds.

The military and many industries are critical of the DO's. A military DO has no priority over the increasing numbers of DO orders from other government agencies and industry. Industries without DO's want them; industries with DO's find them growing less effective as this single priority takes in more orders.

The breaking point comes when there are more DO's than scarce materials. If it comes before July 1, DO's and mobilization administrators who have sponsored them may depart together.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Skin resistance is greatest wherever sensory response is least due to nerve-severing or internal disturbances.

Periodic flashing lights (sun through trees, passing cars, tunnel lights) can cause dizziness or even epileptic disturbances.

Small packaged gasoline-driven generators for either ac or dc or both are attracting attention as back-up for plant auxiliaries during emergencies.

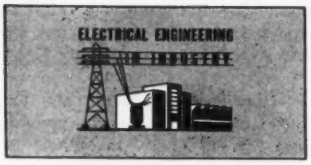
Extra capacity at some sacrifice in thermal efficiency can be achieved by by-passing one or more extraction heaters during peak load.

Thermal converter potentiometer totalizers (30 in series on 20 circuit miles of cable) give simultaneous peak demands at 7 substations of one system.

Microwave channels are expected to constitute 90% of the telemetering on one large interconnection.

Stencilling with some identifying mark to indicate change in maintenance practice is a worthwhile adjunct to later analysis of the efficacy of the change.

Corrugated asbestos wall siding made a wartime power plant building the lowest in cost at the time.

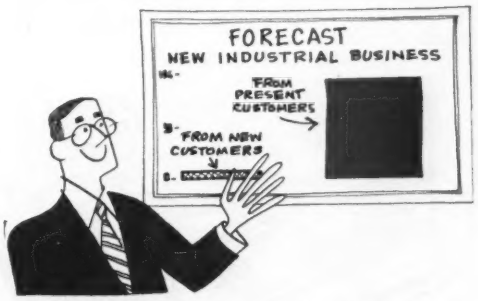


How Power Engineers Can Help Industry Mobilize

Here are nine ways that utility power engineers can help their industrial customers during the present defense mobilization

1. Be his industrial consultant
2. Help solve his technical problems
3. Help solve his production problems
4. Show him new production tools
5. Demonstrate new techniques
6. Tell him about new products
7. Help broaden his markets
8. Be his friend
9. Help increase his profits

W. A. Mac CALLA, Industrial Power Engineer
West Penn Power Co, Pittsburgh, Pa.



Your present customers are your most fertile market

Utility market forecasts as well as the present large scale expansion and electrification of industrial plants indicate that our largest growth and therefore our greatest opportunities for service today lie with our present customers. In fact one company, whose continuous market forecasts have been very reliable in the past, expects that 96% of all the new industrial business will come from existing customers.

Aside from the present defense emergency expansion, this growth of existing customers is also due to the development of new tools, new techniques, new products through research, new markets for these products, and new ways of getting around obstacles that seem insurmountable.

Doesn't it appear, then, that it would pay to direct the major industrial emphasis toward your present customers? By taking care of all our present customers' power needs, large or small, in our very best way, we make them glad to come to us for everything they power—everything they heat—everything they light. Let's take a look at some of our customer's needs.

Be Your Customers' Industrial Consultant . . . Most basically of all, they need good power service. Increasingly important are good voltage regulation, perfect frequency, and better and better continuity of service. To satisfy this need, the top-notch power engineer looks upon himself as the customers' industrial consultant. He considers it his obligation to analyze each customer's problems and requirements and see that each one is getting the proper kind of power service.

In doing this, he takes nothing for granted. He makes sure the customer has adequate transformer and line capacity even back to the substations. He periodically reviews billing records of all important customers, looking for changes in load and load factor which often furnish a clue to changes in the customer's business which may affect both the power company and the customer's service.

As the customers' industrial consultant the electric power engineer goes to bat when he feels that a particular customer should have better than average type of service, such as automatic two-way feed, for example. This may be fully justified in the case of mine ventilation, for instance where a service interruption to the mine might affect a very large number of men underground.

The power engineer who is truly his customers' industrial consultant sees that he is represented in discussions by the system operating department of his company, obviously for the mutual benefit of the customer and the utility company.

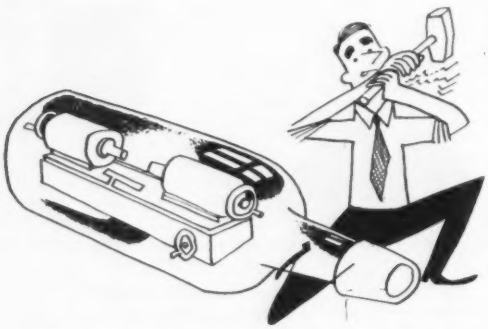
Solve His Technical Problems . . . If the industrial customer has confidence in the utility power engineer he will often ask him to solve technical problems in connection with his use of power. Such problems frequently result both in satisfying customer needs, and increasing kilowatthour sales and good will for the power company. For example, wiring and lighting surveys not only contribute substantially to increased load, but provide the power engineer with a wonderful opportunity to get out in the customer's plant.

And it builds up the power man's acceptance as the customer's industrial consultant to be able to answer such technical problems as motor and switchgear selection, substation design, and power factor control, on the spot without having to call on engineering assistance in his company.

You might question whether technical aids to the cus-

tomer should go as far as in the case of a certain laundry company which used to generate its power with slide valve steam engines. In the course of making a study looking toward the use of power, we took indicating cards on the steam engines. A quick look at the cards showed the valves were set for too early a cut-off for efficient operation. Before we left, we reset the valves, improving the engine's efficiency considerably. Shortly after that, the study was presented to the customer—he abandoned his generating plant. Later he told us that our thoughtfulness and honesty in helping him to get the most out of his engine had a great deal to do with his decision to do business with our company.

Solve His Production Problems . . . Almost all customers have bottlenecks and other production problems which need to be solved. It is both our obligation and our opportunity to help them solve such problems. The winning power engineer has learned to broaden his viewpoint to include an interest in customers' over-all problems, rather than to have a narrow approach based only upon electric equipment.



Help break your customers' production bottlenecks

An excellent approach is the creative method found in the Production Methods Analysis section of our EEI Power Sales Manual. In the course of studying that section of the manual, every member of our power sales staff selected an actual customer's production problem, worked through a solution, and presented it to the customer.

The solution of every problem resulted in a more profitable production method for the customer and generally more power requirements!

One power engineer picked a job for his study that looked like a pretty tough one! His customer's bottleneck was assembling and soldering radio transformer bushings. Also, costs had to be cut to meet competition. Following the PMA routine, the power engineer analyzed the present method and found a better way. The old way—old fashioned hand soldering irons—heavy and slow. The new way —automatic electronic induction heating to flow the solder—motor driven rotating table to move the work. The direct benefits:

1. Production increased from 60 to 1,000 pieces per operator per hour.
2. Cost per unit reduced to one-tenth original cost.
3. Greater pay for the operators.
4. For the power company—56 kva of new heating load.
5. A grateful customer—one who has greatly increased his power requirements since then.

Show Him New Production Tools . . . Fortunately, there are many new production tools to help us insure customer profits. Just two recent ones are the glassless infrared unit and the continuous coal miner which substitutes power for powder. It employs six men as compared to sixteen men in a conventional mechanical unit. It produces at the rate of 80 tons per man-day. Of course, it speeds up the job, cuts mining costs—uses a lot more electric power, incidentally!

Demonstrate New Techniques . . . We can help our customers by showing them new production techniques. We can do this by keeping them abreast of developments, such as the continuous casting of steel, the technique of glass-to-metal welding, and the technique of making alloy clad carbon steel.

During the past year there has been a tremendous interest by glass producers of all types in electric glass melting, whereby melting time can be cut from six or seven days down to 24 hr with quality greatly improved. Electric steel companies are vitally interested in the application of oxygen to their process. One company using oxygen in a six-ton electric furnace reports their time cycle cut one-half hour from a 5-hr cycle.

Through such techniques we can multiply our efforts to introduce time saving and profitable ideas and at the same time make ourselves even more in demand as our customers' engineering consultants.

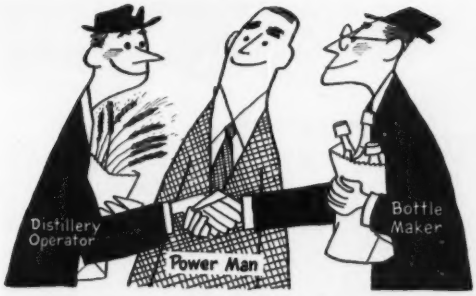
Tell Him About New Products . . . Customers who expect to stay in business are continually looking for profitable new products which can be processed in their plant, and we can often help them.

The power engineer who can find a use for sawdust and scrap wood from the saw mill or planing mill is always happy to do so because of the potential threat of so-called waste fuel. A recent development of this nature is an artificial log made by compressing the wood waste under 20,000 psi. This product is very popular with home owners out in the wood-burning area of the West because it is an economical and clean way to burn wood.

These new products come through research. The enterprising power engineer encourages his customers to set aside some money each year for research.

Broaden His Markets . . . Frequently another customer need is to strengthen and broaden his market. The power engineer can often be of very great help because of his knowledge of other manufacturing within his territory.

During the middle thirties, when business was not too good, an old distillery was reopened in Western Pennsylvania. Not more than 20 miles away was the glass container company which was also struggling to keep going. In less than two weeks' time after the distillery offices had been opened, a meeting was arranged between the distillery and the container officials for negotiating a mutually profitable deal on the supply of whiskey bottles. Results—both operations became more profitable. Need I tell you who arranged that meeting?



Broaden your customers' markets. Introduce him around!

The power engineer has a good opportunity to broaden his customers' markets by helping them to get publicity in the electric company's house organ, as well as in trade and industry magazines. Such publicity creates good will for the power company, too. Some years ago the oldest ice cream manufacturer west of the Allegheny Mountains, who has a large plant and dozens of retail outlets, used to plague me with talk of competitive power. Following a major modernization of this plant, I arranged for a story to be published in a trade magazine. The customer was so proud of this story that he ordered sufficient copies to use in the show-windows of all his stores. Needless to say, I have had no competitive troubles from that customer ever since!

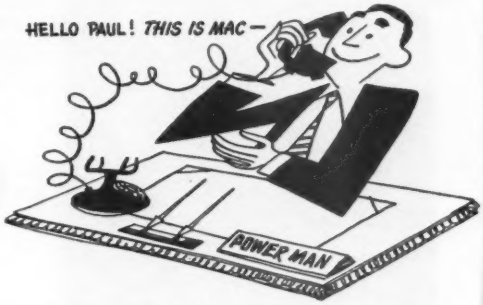
Be Your Customers' Friend . . . But to set the stage most effectively for creatively taking care of customers' needs, it is necessary to be more than just your customers' industrial consultant and to take care of his technical problems.

You must get to know personally the key men in your customers' companies—their wives, kids, idiosyncrasies, and their hobbies. I remember what a tough time I had getting on friendly terms with an engine-minded manager of a water authority until I learned that he, too, was interested in astronomy and, as a matter of fact, was having some difficulty in locating parts for a telescope which he was making. That was an opportunity right up my alley! Since that time we have been very friendly and during the past year I had no trouble at all completing negotiations to serve his large new pumping plant.

Recently I overheard the manager of a large glass company telling his boss that the power engineer who handled his company's account had been so friendly and helpful that he could count on him for constructive help in almost any situation. His wife must have had the same feeling, too, because just the other day I heard she discovered a leak in a gas line at their home. And did she call on the gas company for help? No, sir! She called the electric company, to send a man out to fix the gas pipe!

The winning power engineer calls his customers by their first names at as early a moment as is possible in keeping with good taste. He wants his customers to use his first name. One way he invites this is by the way he answer his phone—by saying, "This is Johnny Jones"—or "This is Dick Smith"—not "Jones talking" or "This is Mr. Smith." If customers know us well enough to call us "Bill," or "Jim," or "Mac," won't we be their friend and their consultant?

In a competitive situation this puts the opposition in a terrible position. One time I was making a "bird dogging" call at a coal customer's office and had the luck to walk in while an engine salesman was making his "pitch." During the ensuing conversation I was plain "Mac" to my customer and he was "Paul" to me and that poor engine salesman didn't have a chance!



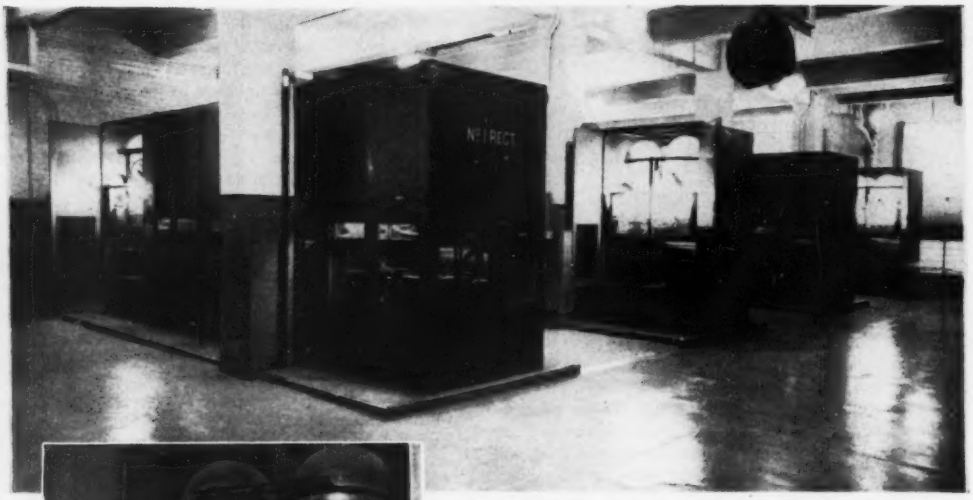
Be your customer's friend. Get to know him well

To his power customer, the utility power engineer is the utility company. If the customer learns to trust and like the utility man, he will trust and like the company. The power engineer has an obligation to see that his company's policies and services do not jeopardize that respect. I think our companies have an obligation to give their men enough policy knowledge, enough freedom of action, and enough compensation so that they can be "the company" to their customers.

Increase Your Customers' Profits . . . The power man must understand his customers' needs, and take care of these needs. When we think of customer needs it is well to remember always that our customers' most important need is profits. There is no exception to this fact in private industry!

Listen to this: A few years before the last war one of our large coal mining customers was having a tough time making ends meet. Largely through the insistence of the power engineer, the customer replaced a 400-hp old-fashioned squirrel cage ventilating fan with a 200-hp modern aerodynamic type fan furnishing the same amount of air. The customer was amazed by our earnestness on his behalf. Since that time, this customer has grown—and we have grown with him.

For articles on
INDUSTRIAL APPLICATIONS
See "Electrical World's"
New Industrial Department
Pages 128 and 129



FOUR UNIT rectifier installations each consist of four individual glass-bulb units (see inset) giving 1,500 kw capacity per unit. Fan draws cooling air up through cubicle base and louvered side walls

We Found Glass Bulb

Low maintenance results from lack

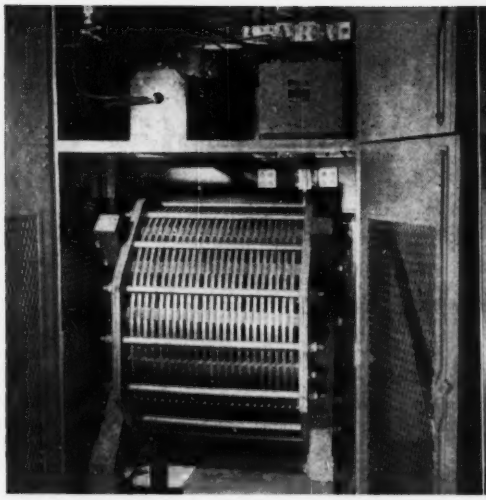
J. H. STEEDE, Executive Asst to Vice-President and Chief Engineer
B. C. Electric Co, Vancouver, B. C.

Simplicity and low maintenance are outstanding advantages of sealed glass bulb mercury arc rectifiers used for transit service by British Columbia Electric in Vancouver, B. C. The sealed tubes operate at ground potential and do not require vacuum pumps, water cooling, pressure gauges or other complicated auxiliaries used by tank-type rectifiers. Absence of a cooling system eliminates the problems of electrolysis and inhibitors to prevent corrosion, and with the sealed vacuum cuts maintenance costs to about half the costs experienced with various types of metal tank rectifiers. Other advantages of the units are low operating costs, installation without heavy foundations, easy inspection of tube condition, and simple tube replacement while operating at 75% capacity.

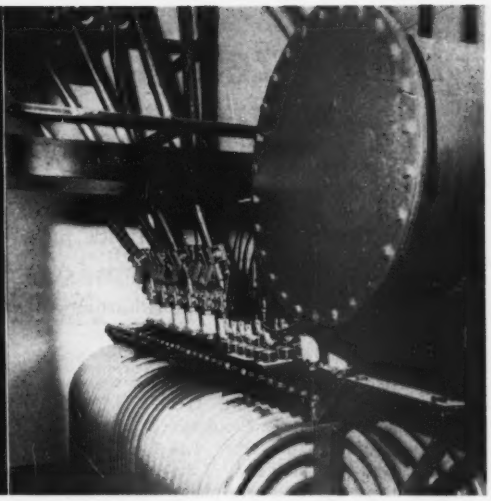
Fifteen Years Experience . . . BC Electric experience with glass bulb rectifiers dates back to 1936, when a 330-kw unit was put in service, to be followed by a similar unit in 1937 and a 660 kw unit in 1938. Operating experience with the equipment was so favorable that a post-war modernization program of replacement of all rotating equipment used in the supply of power to the transit system was the result. The company now has a total of 12,990 kw of this type of rectifier operating, with installation of 7,500 kw planned for 1951.

Unit Installations . . . The equipment is installed in 1,500-kw units. Each unit comprises four cubicles, each cubicle containing four three-phase sealed glass bulbs. The bulbs are rated 163 amp, 575 v (or about 93.8 kw), with standard traction service overload ratings of 50% for 2 hr, 100% for 1 min, 200% for 15 sec. In the 15 years since the first operation, no arc backs have been recorded, and only three bulbs have been replaced. Two of these were in the original 330-kw installation, where they were overloaded and cracked in 1948. The third was replaced shortly after being installed in one of the recent units, and is believed to have been defective. Comparable bulbs are still in service in England after over 25 years of operation.

Low Maintenance . . . Sealed construction of the glass bulbs and few moving parts in the equipment contribute to low maintenance on the



TRANSFORMER TANK contains main 12,000/540-v six-phase winding and interphase transformer, 383/110-v for fan motors, saturable reactors, and starting-holding circuit supply



CONVENTIONAL SMOOTHING EQUIPMENT for dc output of rectifiers is series reactor with resonant shunts tuned for sixth, twelfth, eighteenth, and twenty-fourth harmonics

Rectifiers Simple and Trouble-free

of vacuum pumps, water cooling and other rectifier auxiliaries

units. The high vacuum in the bulbs lasts indefinitely, and if a bulb does lose its vacuum it can be returned to the factory for re-evacuation. Time required to change out a bulb and replace it with a spare unit is about one hour. Design of the cubicles permits isolation of the one concerned without interrupting operation of the other three cubicles in the 1,500-kw unit.

The glass construction also permits easy visual inspection of the bulbs two or three times a week. Cubicle doors can be opened for this inspection without interrupting operation of the units. Loss of vacuum or other abnormalities affecting operation show up immediately in the appearance of the tube. Condition of the anodes is easily noted at the same time.

Starting, Holding Circuits . . . Each bulb incorporates a special auxiliary circuit for maintaining a continuous arc even at no-load. A 70-0-70 v supply for the circuit is in the tanks with the main transformer. A glass-coated electrode rod with a bare carbon tip starts the arc originally. A soft iron armature is mounted on the rod so when the starting coil is energized the electrode is pulled down and up against a spiral spring. The electrode thus makes contact with the mercury pool in the bulb and starts the arc. The circuit to this starting coil is cut out after the bulb is started, and the auxiliary circuit in the bulb then maintains a continuous arc.

Variable Speed Fan . . . Only other moving part of the equipment is a 2 hp motor-driven fan in each cubicle. Saturable reactors in the three-phase power source vary fan speed from idling at no-load up to full speed at half-load on the bulbs. The dc windings of the saturable reactors are a few turns of heavy section conductor connected so each winding carries half the dc load of the bulb. No-load speed of the fans is adjusted by taps on the ac winding of the reactors.

Cooling requirements of the units are 165 cfm of air per kw of loss at an operating ambient temperature of 30 C. With a 93.5% efficiency at full load, losses on a 1,500-kw unit are 97.5 kw, requiring 16,000 cfm. Louvers in the building wall at the second floor level of the rectifier room and an entrance from the transformer bay which is open to the outdoors provide the cooling air required. Exhaust is through manually-controlled louvers in the roof of the building.

Automatic electric heater units pro-

(*Continued on page* 170)

Pulverized Lignite Burned Successfully In Minnesota Power Plant

Operating experience with pulverized lignite opens field for burning lignite in boiler units having capacities of 200,000 lb of steam per hr and above. Tests compare burning of pulverized raw and steam-dried lignite

North Dakota lignite can be pulverized and burned successfully. This result of experience at the Crookston Minnesota plant of the Otter Tail Power Co has been influential in the design of larger lignite-burning plants elsewhere. Moreover it has removed restrictions on the size of boilers burning lignite.

The spreader stoker is more satisfactory for small units, such as those required on the Otter Tail system. This conclusion from experience appears to be true for boilers having a capacity of 100,000 lb per hr and under. For capacities of 200,000 lb per hr and above it appears that the pulverized firing is more satisfactory. For units ranging from 100,000 to 200,000 lb per hr the choice would be influenced by local conditions and preference. Operating men at Crookston Plant, where each boiler has a 75,000 lb per hr capacity, prefer spreader firing.

Fuel Problems . . . In recent years fuel problems have brought with them a growing interest in new or different fuels. As a result of this, lignite has come into the fuel picture to a greater degree and more people are becoming interested in its possibilities.

The Otter Tail Power Co has some territory in the heart of the lignite beds of North Dakota and some outside the areas where lignite is an economical fuel. Of the company's 12 steam plants 10 are equipped for burning lignite, and some of these have provisions for burning either lignite or coal. Two plants burn coal exclusively. Plants in the lignite fields are basically lignite burning plants.

High moisture content is an important factor in the burning of lignite as well as its variable nature. Moisture content of lignite being used by Otter Tail Power Co ranges from 20% to 40%. The fuel varies with the weather, with mines from which it comes and even within the same mine. One mine supplies lignite that varies from 27% moisture and 7,800 Btu to 38% moisture and 6,400 Btu. It changes from day to day. There is also a variation with weather enroute from the mine and where it is stored.

Lignite moves satisfactorily when frozen but gets sticky as it gets into the building and gets warm. It sticks in the hopper, in chutes and right at the boiler. It is difficult to keep it moving.

Lignite is black in appearance and very similar to coal. It is fibrous which makes pulverizing difficult. Also due to the high moisture content the volume and weight of fuel handled is above that of coal required for a given steam output. This means additional size for all fuel handling equipment including stoker or pulverizer, furnace and ash handling.

Also due to the high moisture content it is not economical to ship lignite great distances. This involves paying freight on large quantities of water. Roughly the maximum economical shipping distance is 250 miles.

Good Trial Ground . . . Perhaps one of the best places for studying the burning of lignite is in the Crookston Plant of Otter Tail Power Co. In this plant there are two units of 5,000-kw capacity each and two boilers of 75,000 lb per hr capacity each. One boiler is fired with a spreader type stoker and the other with pulverized lignite.

On the boiler burning pulverizing lignite, tests were made by the Otter Tail Power Co in cooperation with other agencies. These tests were conducted with a view to determining the results of burning pulverizing lignite and to compare the burning of raw lignite with the burning of lignite that has been put through a drying process. Results of the test are given in Tables I and II.

Combustion efficiency when using steam dried lignite is 5.4% higher than when using raw lignite, as shown in Table II. Radiation and convection losses were approximately the same for the two types of fuel.

It was not possible to make arrangements for weighing the total refuse or to collect a representative sample showing the average composition. However a few "grab" samples were taken. Findings are shown in Table III.

Pulverized lignite firing requires high primary air temperature, 650 F, to remove the excess moisture. Actually, operation at Crookston provides a primary air temperature of 700 F. This means that economizers are not used. Two air heaters are required to get the necessary primary air temperature.

Some trouble has been experienced with the vacuum type ash removal due to the greater weight per cu ft of fines as compared with fines from coal. Also there is more lime in lignite fines. Due to the additional weight or lime or both, flyash packs and stands almost vertically.

Burning of lignite, whether pulverized or with stoker, forms a lime coating on boiler tubes. This reduces heat absorption rate of tubes and raises gas temperature going to the superheater. This raises superheater temperature.

TABLE I—Performance Data, Comparative Tests of Pulverized Natural Lignite and Steam-Dried Lignite

General Information . . . One steam generating unit, 75,000 lb of steam per hr continuous capacity; 425 psig operating pressure; 300 F feedwater; 825 F steam temp. Unit consists of BBW-19 WW boiler, heating surface 7,555 sq ft; plus water walls, heating surface 3,400 sq ft; primary air heater, 43,000 sq ft; secondary air heater, heating surface 7,300 sq ft; two No. 5 Riley pulverizers; four No. 3 Riley burners; furnace volume 5,430 cu ft.

	Raw Lignite	Steam-dried Lignite
Type of lignite	Kincaid	Dakota Star
Duration of test, hours	16.07	9.85
Fuel proximate analysis as fired		
Volatile matter, percent	27.9	36.1
Fixed carbon, percent	31.0	41.6
Ash, percent	8.6	6.7
Moisture, percent	32.5	15.6
Heating value per pound, as fired, Btu	7,270	9,170
Fusion temperatures of ash		
Initial deformation temperatures, Deg. F	2,030	2,310
Softening temperature, Deg. F	2,080	2,360
Fluid temperature, Deg. F	2,210	2,470
Fuel Ultimate Analysis, as fired		
Carbon, percent	43.0	55.8
Hydrogen, percent	6.5	5.2
Oxygen, percent	40.7	30.9
Sulfur, percent	0.5	0.6
Nitrogen, percent	0.7	0.8
Ash, percent	8.6	6.7
Gas analysis, boiler outlet		
CO_2, percent	14.35	14.54
CO, percent	0.04	0.01
O_2, percent	5.26	5.58
N_2, percent	80.35	79.87
Excess air used for combustion, percent	32.5	35.6
Dry gas per lb fuel at primary air heater outlet, as fired, lb	7.51	9.60
Dry air supplied per lb fuel as fired, lb	7.21	9.34
Moisture per lb dry air, lb	0.005	0.006
Water (vapor) per lb fuel as fired, lb	0.58	0.463
Pressures and Drafts		
Steam pressure to turbine, psig	422	423
Furnace draft, in. of water	−0.26	−0.24
Draft inlet primary air heater, in. of water	−0.37	−0.58
Draft inlet sec. air heater, in. of water	−0.57	−0.69
Draft outlet, sec. air heater, in. of water	−1.2	−1.12
Draft inlet dust collector, in. of water	−1.2	−1.12
Draft outlet dust collector, in. of water	−1.4	−1.30
Outlet forced draft fan, in. of water	+4.0	+3.87
Inlet primary air heater, in. of water	+3.5	+3.40
Inlet sec. air heater, in. of water	+3.1	+3.72
Main air duct, in. of water	+0.27	+0.15
Burner box No. 1, in. of water	0.0	−0.03
Burner box No. 2, in. of water	0.0	−0.01
Inlet pulverizer No. 2, in. of water	−0.25	−0.25
Temperatures		
Steam to turbine, Deg. F	760	742
Feed water, Deg. F	301	301
Air to primary air heater, Deg. F	438	349
Air from primary air heater, Deg. F	616	497
Air at pulverizer before admission of fuel, Deg. F		495
Sec. air to No. 1 burner, Deg. F	407	332
Sec. air to No. 2 burner, Deg. F	394	313
Prim. air-fuel at pulverizer inlet, Deg. F		354
Prim. air-fuel in coal line, Deg. F	143	187
Fuel to feeder, Deg. F	60.0	67.4
Gas at boiler outlet, Deg. F	635	560
Gas at prim. air heater, Inlet Deg. F	682	557
Gas at prim. air heater outlet, Deg. F	635	527
Gas at sec. air heater outlet, Deg. F	395	317
Gas at dust collector outlet, Deg. F	384	305
Gas at chimney inlet, Deg. F	371	305
Furnace Temperatures, Deg. F		
Ash pit No. 1 side	1,640	1,712
At burner flame No. 1	2,050	2,397
At burner flame No. 2	2,030	2,402
At center of furnace No. 1	2,005	2,084
At center of furnace No. 2	2,000	2,078
Near real wall No. 1	1,755	1,757
Near real wall No. 2	1,767	1,807
Slag screen area No. 1	1,655	1,763
Slag screen area No. 2	1,715	1,796
Slag screen area No. 3	1,727	1,768
Slag screen area No. 4	1,725	1,766
Slag screen area No. 5	1,730	1,743
Enthalpy		
Feed water, Btu/lb	270.6	270.6
Steam to turbine, Btu/lb	1,393.4	1,383.6
Heat added in boiler, Btu/lb	1,122.8	1,113.0
Hourly Quantities		
Fuel as fired, lb per hr	6,670	5,212* 5,050
Moisture free fuel, lb per hr	4,502	4,399 4,262
Fuel as fired, lb per cu ft furnace	1.23	0.93
Actual water, lb per hr	33,012	33,910
Heat units released in furnace, Btu per hr x 10^6	48.491	46.309
Heat units absorbed by water and steam in boiler, Btu per hr x 10^6	37.066	37.742
Heat units released in furnace, Btu per hr per cu ft	8,930	8,528
Air consumption, lb per hr	48,077	47,182
Moist gases produced, lb per hr	53,934	50,818
Dry gases produced, lb per hr	50,065	48,480
Water vapors produced, lb per hr	3,869	2,338
Water vapors from moisture, lb per hr	2,168	788
Water vapors from combustion of hydrogen, lb per hr	1,701	1,560
Evaporation		
Steam generated per lb lignite as fired, lb	4.95	6.71
Steam generated per pound dry lignite, lb	7.33	7.96
Efficiency		
Efficiency of boiler furnace, percent	76.4	81.5
Electrical Data		
Average load per hr, kw	3,254	3,196
Heat input, Btu per kw hr	14,902	14,481
Lignite consumed as fired, lb per kwhr	2.05	1.58

* This recorded coal weight has not been used for the calculation of the performance data due to irregular functioning of the automatic scale.

	Raw Lignite (Kincaid)		Steam-dried Lignite (Dakota Star)	
	Btu	Percent	Btu	Percent
Heat absorbed by water and steam in the boiler	5,557	76.4	7,474	81.5
Heat loss due to the moisture in the fuel	381	5.2	177	1.9
Heat loss due to water from combustion of hydrogen	299	4.1	349	3.8
Heat loss due to moisture content of air	6	0.1	7	0.1
Heat loss due to dry chimney gases	610	8.4	604	6.6
Heat loss due to unconsumed combustible in refuse, unconsumed hydrogen, hydrocarbons, radiation, convection and unaccounted for	417	5.8	559	6.1
	7,270	100.0	9,170	100.0

TABLE II—Losses Calculated From Test Data

	Raw lignite, %	Steam-dried lignite, %	Difference, %
Heat loss due to the moisture in the fuel	5.2	1.9	−3.3
Heat loss due to water from combustion of hydrogen	4.1	3.8	−0.3
Heat loss due to dry chimney gases	8.4	6.6	−1.8
Total loses	17.7	12.3	−5.4

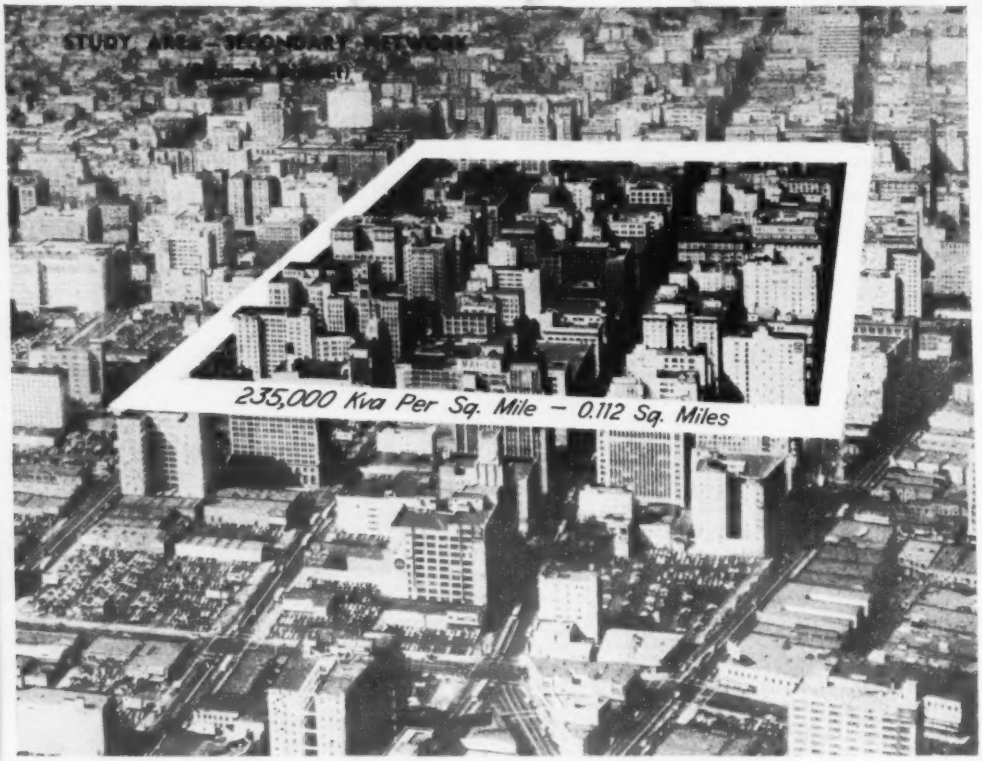
TABLE III—Tests of Refuse Samples

	Raw lignite, % carbon	Steam-dried lignite, % carbon
Carbon Content		
Pneumatic system at ash pit	6.7	5.1
Ash pit quenched	15.4	9.1
Boiler hopper	1.4	4.4
Cyclone separator	1.1	1.7

Heat losses due to carbon content of refuse:

A. Raw lignite
- Ash content as fired, 8.6%
- Refuse per lb lignite as fired:
  - Ash 0.0860 lb
  - Carbon 0.0012 lb
  - Total refuse 0.0872 lb
- Heat value of carbon (taken from analyses of char) = 16,000 Btu per lb
- Potential heat of 0.0012 lb carbon = 19.2 Btu
- Loss due to combustible in refuse = 0.26% of heat value of raw lignite.

B. Steam-dried lignite
- Ash content as fired, 6.7%
- Refuse per lb steam-dried lignite as fired:
  - Ash 0.0670 lb
  - Carbon 0.0031 lb
  - Total refuse 0.0701 lb
- Potential heat of 0.0031 lb carbon = 49.8 Btu
- Loss due to combustible in refuse = 0.54% of heat value of dried lignite.



HIGHEST DENSITY load area studied is in heart of downtown Los Angeles business district, but underground secondary network still cost $54 per kva compared to a cost of $44 per kva for radial distribution with bus regulation

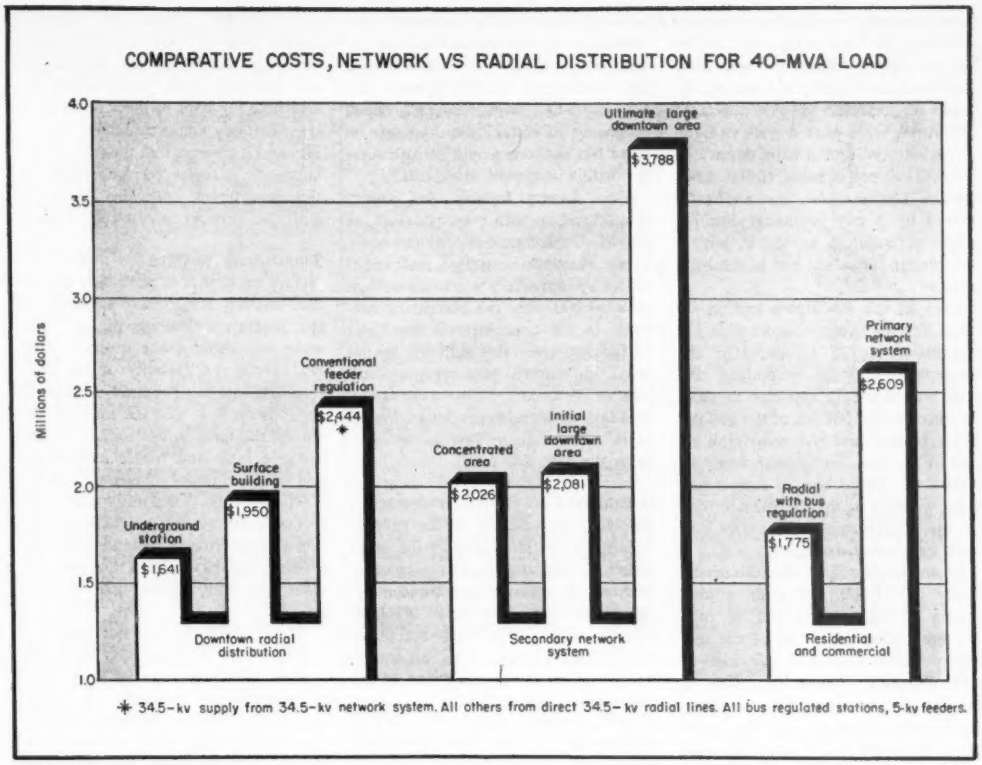
Costs Favor Radial Over Network

Comparative studies for Los Angeles show higher costs even under most favorable conditions for primary or secondary networks compared to bus-regulated radial distribution

Detailed studies have shown estimated costs of either secondary network or primary network distribution in Los Angeles to be substantially higher than for radial distribution with a major type bus-regulated distributing station giving comparable service. Most favorable comparison for a network in the highest load density area in the city showed a saving of nearly 20% for a radial system with bus regulation. Ultimate expansion of a network system necessary to cover the downtown area would increase the gap to nearly 60%.

Two Part Study . . . The study was divided into two major parts. First compared a 120/208-v secondary network and a 5-kv radial system with bus regulation (both underground) to serve the high load density downtown area. Second compared a 5-kv primary network and a 5-kv radial system in a combined business and residential area with both underground and overhead distribution. In both cases the detailed cost studies providing for comparable service were found to be substantially in favor of the radial scheme.

Three Conditions . . . Secondary network in the downtown area was studied for three different conditions. First was for a relatively small downtown area of high load density with future load of 37,500 kva, the entire load of the area to be served from network distribution. Second was for a larger downtown area with initial load to consist of present dc loads plus 2,400-v radial load unconverted as of Jan. 1950, to the standard 4,800 downtown voltage. Network capacity would be expanded with all new load growth up to a future maximum of



COST ADVANTAGE of radial over secondary network in downtown area varied from about $385,000 to $2,147,000. In combined business-residential area bus-regulated radial distribution investment is $834,000 under primary network

in Downtown Los Angeles

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37,500 kva. Third condition was for complete coverage of the downtown area with all new loads and present 2,400-v and dc loads added to the network up to a future maximum of 37,500 kva.

Cost of each of the three network installations was then compared with the cost of providing similar capacity from a new major distributing station and associated radial feeder system. Combined capital costs and transformer losses were less for the major station and radial feeders than for secondary network, as shown.

Development of the network for the first condition was based on these assumptions:

1. Load to be served equivalent to that of a 40,000-kva conventional distributing station with a normal year maximum demand of about 37,500 kva.

2. It would be feasible to design and operate a network using 34.5-kv feeders and transformers, although maximum voltage actually used in the U. S. for network feeders at the time of the study was 27 kv.

3. One 750-Mcm three-conductor, paper-insulated, gas-filled, lead-sheathed cable would carry 20,000 kva at 34.5 kv, and three 34.5-kv feeders of this size would serve either the station or the network.

4. Either system would utilize existing facilities (conduits, manholes and services) to a maximum.

5. Costs were based on conductors for new feeders having synthetic insulation, but also took into account use of existing lead-covered cable in dc networks.

6. Since the area under consideration would be completely covered by the network the installation is given credit in the cost summary for the net value of material which might be recovered from existing radial system.

Effect of Load Density . . . Area of the downtown section selected for the comparative cost study of the first condition is approximately 0.112 sq mi. Excluding all large transformer sta-

tions presently installed on consumer premises, the load density is 235,000 kva per sq mi, highest for any comparable area in the city of Los Angeles. Based on expected growth, this area will in ten years have a peak demand of 37,500 kva and a load density of 335,000 kva per sq mile. (Load densities in Los Angeles are indirectly limited by a city ordinance limiting height of buildings to 150 ft, with a consequent spreading out of business areas.)

Area of the downtown section selected for the second condition is approximately 0.725 sq mi. On the assumption that the secondary network would supply capacity to serve the unconverted portion of the 2,400-v radial system and the remaining dc load in the area, initial load would be 6,700 kva. Initial cost of such a network would actually be greater than for the concentrated 37,500-kva network previously described.

When developed to its ultimate capacity of 37,500 kva with a load density of 52,000 kva per sq mile (the third condition), cost of the secondary network is $94 per kva of peak demand. This corresponds to $47 for the network in the concentrated area, showing that the completed unit cost of a large network can be nearly twice as great as a network serving a concentrated load of similar magnitude.

Radial Comparison . . . Radial distribution in the downtown area was also studied for three different systems—an underground station with bus regulation, a surface station with bus regulation, and a surface station with individual feeder regulation. Before comparing costs of radial and network distribution, expected performance of bus regulation was investigated. Study of actual lengths and loading of feeders showed that bus regulation with feeders grouped according to voltage requirements on three bus sections would furnish service within accepted standards.

Cost figures favored the underground station with bus regulation, as shown. On a capital investment basis, a new distributing station and radial feeder system offers a cost advantage of $384,000 over the secondary network in the concentrated area, and $2,146,900 over the network in the larger downtown area proper—savings of 19% and 57% respectively. Addition of transformer losses for 25 years reduces these savings by only approximately $42,000.

Reliability . . . The high degree of reliability in case of feeder outage, which is claimed as one of the chief technical advantages of a secondary network, is accomplished on the department's radial system in high density areas by primary automatic transfer equipment. This automatic transfer is on the primary side of the transformer, and unlike the secondary network system requires no reserve transformer capacity for emergency conditions.

Operational difficulties experienced by other utilities with ac networks indicate that it is desirable to limit size of each network to about 40,000 kva and to feed each network from a single source. Each network being fed from a single station suffers a complete outage when the source station has a compete outage or a complete bus section is faulted. The June 1949 EEI report "AC Network Operations for 1944-46" shows that approximately 96% of total network outages were due to causes not inherent in the network, with transmission responsible for 40% of these outages. It is evident that complete outages do occur, and it appears that the dual-feeder automatic transfer service system of the department compares favorably with the network method of service.

Transformer Loading . . . In a secondary network it is customary to provide enough transformer capacity so the maximum loading of any unit when one feeder is out of service does not exceed the capacity of the unit. Installed capacity required necessarily depends on how well the load divides among the units as determined by impedance ratio and feeder interlacing, and on the number of feeders supplying the network. Ideal minimum transformer capacity can be realized only if the transformers are loaded exactly to their capacity, and if the load divides uniformly among the units in service.

These conditions do not occur in practice; as an example, with six feeders the ideal ratio of peak load to transformer capacity is 0.83, whereas the usually attainable ratio is about 0.61. The most recent report of the EEI covering data from 80 companies operating 272 networks in 168 localities indicates that load served by these networks in 1946 was 2,931,237 kva, while installed transformer capacity was 5,401,672 kva, a ratio of 54.3%.

Obviously the ideal 100% loading with the automatic primary system used by the department could be realized only if each transformer carried a peak load exactly equal to its rated capacity. The highest practical obtainable loading without overload on the department's system is calculated to be 83.7%. Actual utilization from 1945-1949 has varied between 77.0% and 81.7%. Comparison of the national utilization of network capacity of 54% to the department's utilization of 77% indicates a possible difference of one third in installed transformer capacity for equivalent loads.

Other local factors favoring radial distribution are existing 240-v wiring, unavailability of space for vaults beneath sidewalks, and an increasing trend to serve building loads of 600-

Comparative Costs of Secondary Network vs. Radial Distribution (Load, 40 Mva)

Method of Providing Capacity	Additional Capital Investment	Investment per kva	Evaluated Transformer Losses, 25-Year Period
Secondary Network System:			
Concentrated load area	$1,026,000	$54.00	$327,552
Large downtown area (initial)	2,081,200	310.00	
Large downtown area (ultimate)	3,788,600	101.00	
Station and Radial Distribution:			
New above-ground station	$1,950,000	$2.50	$369,111
New underground station	1,641,700	43.78	
New above-ground station with individually-regulated feeders	2,444,200	65.18	

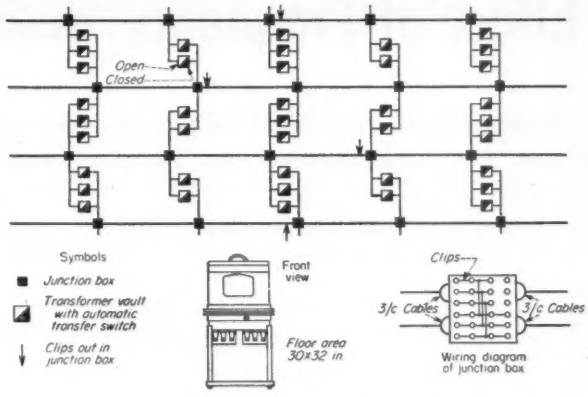
Notes: Station transformer loss factor 0.25.
Cost of energy 6 mils for station, network transformers; 7.5 mils for 5-kv transformers.

3,000 kva with individual transformer installations similar to those of a radial system, using 480-v secondary distribution within the building.

The savings shown above indicate a definite economic advantage for radial distribution under the conditions in downtown Los Angeles. The further considerations of reliability, transformer loading, space requirements and operation also appear to favor retention of a radial system with bus regulation for all future downtown stations.

Primary Network . . . To complete the over-all review of distribution system design, application of a primary network was investigated. A 40,000-kva 34.5/5-kv primary network system in the downtown area would require six to eight uniformly spaced stations with interlacing 34.5-kv underground cable. High property cost and restricted street space make such a system impractical and uneconomical in this area. Therefore an outlying combined business and residential section of the city was chosen for the study. Total area of the section is 3.87 sq miles; initial load 26,500 kva; load density 6,850 kva per sq mile. Spot commercial loads of a highly developed business center approach 27,500 kva per sq miles in a 1 x 0.1-mile strip within the area.

An accompanying table shows comparative costs for a 5-kv primary network of eight 5,000/7,500-kva package unit type stations, and a radial distribution system served from one 40,000-kva large distributing station. Both capital investment and present work are substantially more for the primary network system than they are for the radial system.



Automatic Transfer—Key to Reliability

Automatic transfer switch arrangement on LADW&P's underground radial distribution system has established reliability comparable to network performance. Switch is self-contained and operates on the primary side of the transformer. Transformer normally carries only its specified feeders; on an outage these feeders are automatically distributed among the remaining units according to prearranged setup. As load conditions change, redistribution of feeder circuits is accomplished by simple changing of clips in junction boxes.

Several primary network systems were set up on the ac network analyzer to study load flow, voltage regulation, line loading, and required capacities and operating conditions before this network was determined to be the most satisfactory combination. Normal firm rating of the eight 5,000-kva stations was assumed to be 36,000 kva, since unequal load division between the stations would allow the average station to carry only about 90% of the rated bank capacity. Line outage conditions may put as many as three stations out of service simultaneously, leaving five units with an emergency rating of 7,500 kva each, a total of 37,500 kva. This compares with the firm capacity of a major 40,000-kva station based on an outage of one three-phase bank with the remaining two operating under forced-oil conditions.

With one 34.5-kv line and three stations out of service, load could be carried from the network without exceeding the emergency rating of any transformer, and without serious overloading of any 34.5-kv or 5-kv conductor. Under peak load conditions

(*Continued on page* 169)

Comparative Costs of Primary Network vs. Radial Distribution

I—Capital Investment

Primary network system, 34.5-kv supply		$2,609,000
Radial distribution bus-regulated major station, radial 34.5-kv supply, 5-kv feeders, circuit breakers	No 34.5-kv	1,775,000

II—Total Present Worth for a 25-Year Period

Year		Primary Network System	Radial Distribution Bus Regulated Major Station
1950	Station, 34.5-kv lines and 5-kv feeders	$2,550,320	$1,647,000
1957	Station, 34.5-kv lines and 5-kv feeders	218,521	111,437
Annuity payments, energy losses less unused life		1,318,830	1,029,946
	Net Present Worth	$4,087,671*	$2,788,383

* If 34.5-kv breakers and supervisory control are eliminated, the net present worth is reduced to $3,817,428.

Costs based on 25-year service, include:
Initial cost of all new construction of stations, feeders, 34.5-kv cables and receiving station line positions.
Sinking fund annuities for depreciation of equipment.
Losses in transformers, feeders, and 34.5-kv cables.
Unused life at end of 25-year period.

Assumptions:
Interest rate 2% per annum.
Unused life on straight line depreciation.
Average life—electric equipment 28 yr, 34.5-kv cables 25 yr, feeders 34 yr, structures 45 yr.
Cost of transformer and 34.5-kv cable losses, 6 mils.
Loss factor 25%.

Effect of Frequency Reduction on Plant

Results are outlined for subnormal frequency operation of 14 equipments and system load and interconnections, also operating practices are given for load relief

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How Reduced Frequency Affects Operation Of Plant and System

1. Reduced speed of motor-driven generating station auxiliaries, such as fans, pumps and mills, will bring about a reduction of plant output by as much as 30%, for a 10% reduction in frequency, whenever these auxiliaries are operating at maximum capacity.

2. Turbine capability is reduced approximately 1%, for a 10% reduction in frequency, which may prove to be a serious limitation in an emergency. Due to the limited range of turbine governor speed changers, difficulty in synchronizing additional generators to the bus will generally occur when frequency is 2 to 5% below normal.

3. Generator efficiency is very slightly affected, for a 10% reduction in frequency; however, reduced speed of the generator cooling fans will reduce the capacity of the cooling system which may affect the thermal limits of the machine.

4. Reduced frequency at any point of a system pulls down the speed of the entire interconnection. This is in marked contrast to the effective use of voltage reduction wherein it is possible to localize the voltage reduction to the area requiring load relief.

5. The characteristic of connected load will affect the results obtained by frequency reduction. Tests made on the Consolidated Edison System show that a frequency reduction of 3%, with bus voltage kept constant, produced no measurable load change.

6. Since frequency reduction results in no load rejection on our system but introduces the liability of reduced plant output, our Company uses voltage reduction as to the initial means of obtaining load relief, and if this is insufficient blocks of customer load are dropped.

Operation of an electric system today requires the highest possible reliability of service to the customer consistent with economic justification of the costs of such service. Under certain load conditions and capacity limitations there may be a deficiency of generation. Reduction of voltage will reduce load and this has been applied for emergency load relief. It has been proposed and some systems have utilized a reduction in frequency as a means of reducing load.

Tests were made and operating characteristics were reviewed to determine the effects of reduced frequency on the output of boilers and turbines. Conclusions based on our tests are presented in the box at the left.

Tests . . . To determine the effect of low frequency on pulverized coal-fired boilers and boiler auxiliaries, tests were made on No. 90 boiler and No. 9 turbine at the Sherman Creek Station. This turbine-generator was supplied by a single 1,000,000-lb/hr boiler fired with coal supplied by two pulverizers and the unit operated at approximately two-thirds capacity. Both mills and mill coal freeders were supplied from an isolated bus section and generator. The main generator was connected to the regular station bus. Tests were run at 60-cycle, 57-cycle and 54-cycle frequencies. Boiler feed pumps, induced draft fans and forced draft fans are driven by steam turbines and the effect of reduced frequency on these was simulated by reducing the speed of the driving turbines.

Capacity and on System Operation

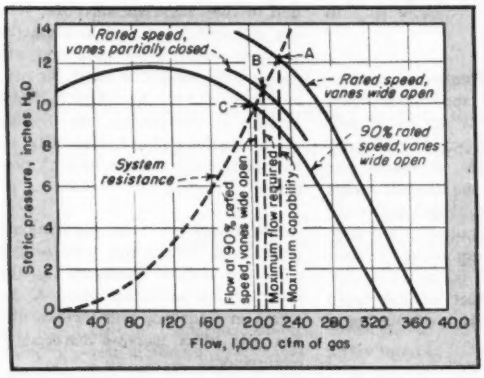


FIG 1—EFFECT of speed of forced-draft fan on the air flow

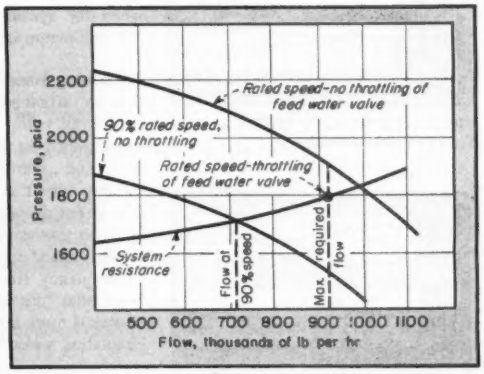

Rated speed-no throttling of feed water valve
90% rated speed, no throttling
Rated speed-throttling of feed water valve
System resistance
Flow at 90% speed
Max. required flow
Pressure, psig
Flow, thousands of lb per hr

FIG 2—EFFECT that boiler feed pump speed has on output

Mills . . . A 10% reduction in frequency on the circuit to the coal mills and coal mill feeders caused a reduction of 12% to 14% in boiler output, with a fixed position of the mill feeder regulators. This was due entirely to the reduction in the quantity of coal supplied to the mills. With automatic combustion control, the variable speed drives of the mill coal feeders fully compensated for the reduction in speed and maintained the required steam flow.

Fans . . . A reduction of 10% in the speeds of the turbine-driven forced and induced draft fans resulted in a decrease of 10% in gas and air flow through the boiler. Characteristic curves of a representative motor-driven forced draft fan are given in Fig 1. Maximum capability of 230,000 cfm is obtained at point A. For normal operation of the boiler at full load the control vanes would be partially closed to limit the flow to 214,000 cfm (point B) for each forced draft fan. As the speed is gradually reduced by a lowering of frequency, the control vanes will open until they are completely open. During part of this speed reduction no change in flow will result. At 94% speed the vanes will be fully open with a flow of 214,000 cfm. Further speed reduction will drop the flow to 207,000 cfm at 90% speed at point C. However, this would not necessarily reduce the steam flow since the reduced air flow may be somewhat compensated for by operating with less excess air. Operation with lower than normal excess air will increase furnace temperatures and slagging conditions with resulting loss in capacity if this condition continues. It is also important to note that an increase in stack discharge may occur.

Boiler Feed Pumps . . . A 10% reduction in the boiler feed pump speed reduced the pump output 33% with approximately the same reduction in turbine-generator output. Fig 2 shows representative motor-driven boiler feed pump characteristic curves for rated and 90% speeds. At rated speed the pump is capable of delivering the flow required by the boiler at maximum output at 1,900 psi, whereas only 1,800 psi is actually needed to pump the required water to the boiler. Excess pressure is taken up by the throttling of the feedwater control valve. As the frequency reduction changes the pump speed, the valve will open and supply the water demand until perhaps 96% of rated speed is reached. As the speed is further reduced to 90% the flow decreases. Here again some excess capacity would be provided nominally either in the individual boiler feed pumps or by a spare pump. Therefore, the actual reduction in boiler capability resulting from a drop in frequency on the motor-driven boiler feed pumps depends on how much extra capacity is immediately available at the time of the emergency.

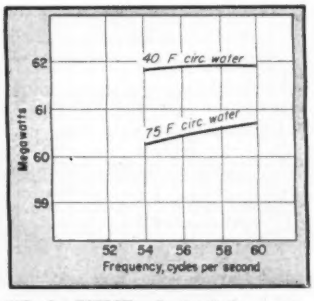


FIG 3—EFFECT of circulating water pump speed on turbine-generator output

Hot Well Pumps . . . Operating characteristics of motor-driven condenser hot well pumps are similar to those of boiler feed pumps resulting in a loss of about 25% in capacity for a 10% reduction in frequency.

Fuel Oil Pumps . . . If oil had been used for firing, a 10% reduction in the speed of our constant-displacement fuel oil pumps would have resulted in a 10% decrease in pump output. If all pumps are operating with no

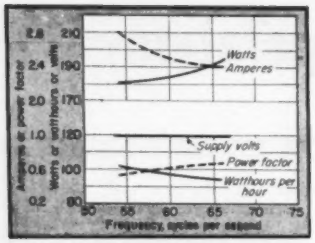


FIG 4—FREQUENCY'S EFFECT on a domestic electric refrigerator

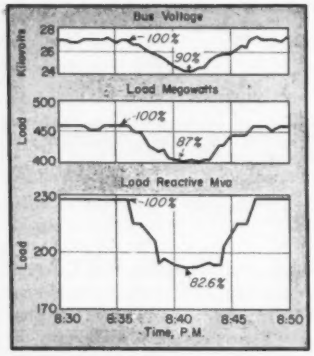


FIG 5—EFFECT of voltage on the system load at a constant frequency

by-passing of oil and the frequency drops 10%, the oil supplied by the pump to the boiler is reduced and therefore the boiler output will drop 10%. However, with normal design there would be sufficient by-passing of oil and hence no change in boiler output would be expected.

Generator and Turbine Output . . . Calculations indicate that a 10% reduction in frequency increases generator efficiency about 0.1%. Generator cooling fans will be operating at lower speed which will reduce the hydrogen or air flow in the cooling system and may affect the thermal limits of the machine depending on the duration.

Calculations made by one of the turbine manufacturers indicate that a 10% reduction in frequency, with steam conditions and flow kept constant, reduces the turbine capability about 0.9%. While another turbine manufacturer states that damage may result to certain low-pressure stage wheels due to inadequate margins for axial and tangential vibration with continued operation at 10% reduced frequency. It should be pointed out that due to the limited range of turbine governor speed-changers difficulty in synchronizing additional generators to the bus will generally occur when the system frequency is 2 to 5% below normal.

Circulating Water Pump . . . A reduction in speed of the motor-driven circulating pump for the steam condenser increases the turbine back pressure and therefore decreases the turbine output if the throttle steam flow is not changed. Fig 3 shows the effect on maximum output of a change in pump speed corresponding to a drop in frequency from 60 to 54 cycles. Note that the effect of the speed change is more marked with the warm circulating water.

Induction Motors . . . A frequency reduction of 10% reduces the motor speed 10%. Pull-out motor torque varies approximately as the square of the voltage and inversely as the square of the frequency.

Synchronous Machinery . . . Steady state stability of synchronous machinery varies approximately as the product of the internal voltage and the bus voltage and inversely as the frequency.

Excitation Systems . . . A 10% reduction in frequency resulted in a 15% reduction in pilot exciter voltage and a 21% reduction in main generator voltage, with no adjustment to either the pilot or main exciter rheostats. There was no pilot exciter voltage instability at 54 cycles. However, the tests indicated that instability tends to develop at operation below 50 cycles.

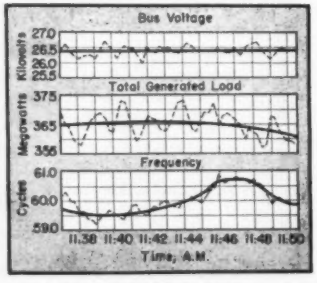


FIG 6—FREQUENCY CHANGE and its effect upon the distributed load

Our study indicates that pilot exciters of conservative design will show no tendency towards instability with a speed reduction of 10%.

Network Relays . . . A 10% reduction in frequency will raise the voltage differential required to close the network protector by 16% and will decrease the current at which the protector will trip by 40%. These changes in the closing and tripping characteristics will not materially affect the operation of the network protector.

Transformers . . . In conventional power and distribution transformers core and copper losses are of the order of 1% of rating each. A decrease in frequency will increase the flux, and hence increase the reactive requirements.

Capacitors and Lines . . . Reactive kva supplied by shunt capacitors and by overhead lines and underground cables varies directly as the frequency and as the square of the voltage. Hence a 10% reduction in frequency and a 10% reduction in voltage will reduce this reactive kva by 10% and 19% respectively, or a combined reduction of 27% in reactive kva supplied to the system.

Home Refrigerators . . . Fig 4 shows the power consumption for a domestic refrigerator at reduced frequencies. While it takes less watts to operate, it must run longer at a lower efficiency to maintain the controlled temperature. Under such conditions, the coincident load for a refrigerator or any similar automatic equipment will first decrease and then slowly increase to a load greater than at normal frequency.

System Load . . . As to voltage reduction, a decrease of 10% in voltage with the frequency approximately constant reduced our system load 13% and reactive load about 17%. These tests are shown in Fig 5. The limits of voltage reduction are determined by the limits of customer's equipment, or about 10%.

As to frequency reduction, tests made on part of our system, shown in Fig 6, failed to detect any significant change in system load with frequency

(*Continued on page* 167)

Appliance Motor Starting-Dips Call For Industry Analysis

Motor manufacturers and utilities should ascertain relative costs of alleviating voltage dips by improving motor behavior and by investment to reduce utility service impedance

JOHN W. ANDERSON, 3rd
General Superintendent, Philadelphia Div, Transmission and Distribution Dept
Philadelphia Electric Co

A major need of the electric power industry is an appliance motor that produces less voltage flicker during starting. Certainly the electric utility needs it. Appliance manufacturers should also be interested in a development that would materially improve a critical design limitation—viz, minimum voltage at motor terminals at the instant of starting.

The objective should be a motor which will operate at low leading power factor during the starting period and will therefore produce smaller starting voltage dip. Specifically, the following are recommended for the consideration of manufacturers of 115-v motors:

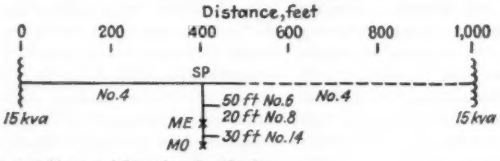
1. Development of designs for ¼-hp and larger motors having locked rotor currents of about same magnitude as present designs but having locked rotor power factors of the order of 60% leading.

2. Development of designs for ¼-hp and larger motors having locked rotor currents up to 50% greater than present designs and having locked rotor power factors of the order of 45% leading.

3. Development of shunt and/or series line starting capacitors having a power factor of the order of 2%, in suitable microfarad ratings to be used in parallel with or, in combination with suitable autotransformers, in series with small motors during the starting period.

Design Trend . . . In the development of the motor-driven appliance market in past years, there has been a tendency on the part of appliance designers to give insufficient attention to the matter of motor starting currents. Considering the fact that in some cases quite high starting torques are required and the fact that in general, motor

TABLE I—Comparative Effectiveness of Various Methods of Reducing Starting Flicker



1/2-hp, 115-v Motor and Secondary Combination	Item	Flicker, Volts SP†	ME	MO	Flicker, Relative SP	ME	MO
Motor * on 15-kva transformer and..... 400 ft No. 4 secondary	1	8.42	10.59	14.80	1.00	1.00	1.00
..... Secondary as in 1, with autotransformer at 500 ft	2	4.89	7.12	11.46	0.58	0.67	0.78
..... Secondary as in 1, banked with second transformer at 1,000 ft	3	5.04	7.28	11.61	0.60	0.69	0.79
Combination of 2 and 3	4	3.79	6.04	10.42	0.45	0.57	0.71
Motor on 15-kva transformer and 400 ft No. 1/0 secondary	5	5.09	7.25	11.58	0.60	0.69	0.78
Motor on 25-kva transformer and.....400 ft No. 2 secondary	6	5.94	8.15	12.44	0.70	0.77	0.84
.....400 ft No. 2/0 secondary	7	4.10	6.35	10.71	0.48	0.60	0.72
Motor on 5-kva transformer on service pole	8	3.46	5.71	10.10	0.41	0.54	0.68
Motor with 1,500-μf shunt starting capacitor.....10% P. F.	9	4.93	6.72	11.58	0.59	0.63	0.80
(Of indicated power factor) .....3.5% P. F.	....	3.92	5.45	10.04	0.47	0.52	0.68
.....0% P. F.	....	3.43	4.83	9.13	0.41	0.46	0.62
Motor, on 15-kva transformer and 400 ft No. 4 secondary with present locked amp @ .....80% P.F. lead	10	4.63	6.17	10.31	0.55	0.58	0.70
.....70% P.F. lead	11	3.57	4.88	8.56	0.42	0.46	0.58
.....60% P.F. lead	12	2.57	3.63	6.83	0.31	0.34	0.46
.....50% P.F. lead	13	1.59	2.39	5.11	0.19	0.23	0.35
Motor, on 15-kva transformer and 400 ft No. 4 secondary with 150% locked amp @ .....60% P.F. lead	14	4.26	5.86	10.59	0.51	0.55	0.72
.....50% P.F. lead	15	2.89	4.14	8.17	0.34	0.39	0.55
.....40% P.F. lead	16	1.50	2.38	5.69	0.18	0.22	0.38

* In items 1 through 9, motor as now designed. † SP-service pole ME-meter MO-motor

costs bear an inverse relationship to magnitude of locked rotor current, this tendency is perhaps but natural in this field where competition is so keen. Thus these developments have placed the burden on electric utilities to provide at their own expense whatever distribution facilities are necessary for minimizing starting current flicker, regardless of whether revenue from operation of the appliance is sufficient to justify the expenditure.

Analyses have indicated that material reductions in starting voltage dips can be attained with combinations of motors and accessory equipment designed to draw starting currents from the line at low leading power factors.

Capacitor Start . . . A motor inherently must start and run at some lagging power factor. Accessory equipment is therefore necessary to secure operation at leading power factor. A beginning is made in this direction in the common capacitor-start motor where the auxiliary or starting winding is provided with a series capacitor with the result that that winding operates at leading power factor. The line current (ie, the combination of the currents in the starting and main or running windings) is, however, in the lagging power factor range. What is proposed here is the development of a motor—with accessory equipment—with line current in the low leading power factor range during the starting period.

Suppose by some means the locked rotor current of a typical motor can be maintained constant (ie, constant locked rotor impedance) except that its power factor is gradually changed to 50% leading. Starting voltage dips at the service pole, at the meter, and at the motor are materially decreased with leading power factors.

Shunt Capacitor . . . Another method of achieving leading power factor in the supply circuit is of course the use of a shunt capacitor close to the motor terminals. Substantial improvement by this method also is indicated, especially with capacitors of low power factor; however, except for relatively small changes beyond the initial power factor, this method generally does not produce as great an improvement as maintaining constant current. The advantage gained by phase displacement at the low leading power factors is partially offset by the increased magnitude of line current. The power factor of the combined current is, however, a low leading value, illustrating another important point, namely: Substantial voltage dip improvement can be effected even with locked rotor currents considerably greater than those now in general use provided that these currents are at a sufficiently low leading power factor.

Table II—Average Drop Ratio at Service Pole

Item	Description	Avg. Drop Ratio*
1	Motors as now designed	4.37
2	Same as 1 with shunt starting capacitors of 10% pf—mixed μf ratings	2.51
3	Same as 2, except other mixed μf ratings	2.48
4	Same as 2, except μf ratings to give line power factor of 50% leading	2.48
5	Same as 2, except 1500 μf with each motor	2.43
6	Motors present locked amp @ 80% pf leading	2.39
7	Motors 150% locked amp @ 60% pf leading	2.20
8	Same as 1 with shunt starting capacitors of 3.5% pf; mixed μf ratings	1.95
9	Same as 8, except μf ratings to give line power factor of 50% leading	1.92
10	Same as 8, except 1,500 μf with each motor	1.88
11	Motors present locked amp @ 70% pf leading	1.84
12	Same as 1 with shunt starting capacitor of 0% pf; 1,500 μf with each motor	1.57
13	Motors 150% locked amp @ 50% pf leading	1.52
14	Motors present locked amp @ 60% pf leading	1.33
15	Motors present locked amp @ 50% pf leading	0.83
16	Motors 150% locked amp @ 40% pf leading	0.82

* Average drop ratio = $\frac{\text{starting voltage drop}}{\text{running voltage drop}}$

Comparative Effectiveness . . . In Table I starting dips at leading power factor (Items 9 to 16 inclusive) may be compared with those obtained by conventional methods of improving flicker voltages (Items 2 to 8 inclusive), such as autotransformers, secondary banking, larger sizes of transformers and/or secondary copper, and shortening the length of the secondary by installing an additional transformer on the service pole. It will be noted that the improvement obtained by the leading power factor method is generally superior to that resulting from the conventional methods.

Significant reductions in troublesome motor starting voltage dips can be effected with leading power factor starting currents. But how far should the development be carried? The final answer of course can be determined only by over-all economics. For the purpose of initiating the development, it seems logical to relate motor starting voltage dips to the voltage drops resulting from the running currents of the devices and then, on the basis of such relationships, to make specific recommendations for the consideration of motor manufacturers.

Practical Limit . . . Obviously the electric utility must be prepared to provide facilities adequate for the running drop and there is no logic in requiring starting drops to be less than running drops.

Consequently, the recommendations contained herein are based on an analysis of the relation between starting drops and running drops at the service pole. For this purpose, four motors on four transformer-secondary combinations have been studied. Drops at the service pole have been chosen as the criterion because it is drop up to this point that affects *all* customers on the secondary. The four motors cover horsepower ratings of ¼, ⅓, ½, and ¾, and are believed to be typical of present-day motor designs; the four secondary combinations cover a range of transformer ratings and wire length and sizes so chosen as to present extreme as well as probable average conditions.

On the above basis, it was found that the four motors on the four transformer-secondary combinations produce starting voltage dips at the service pole ranging from 3.45 to 4.90 times the running voltage drop at the same location. The average ratio is 4.37. With this as a starting point, similar ratios have been computed for a number of conditions involving leading power factor starting currents. These ratios, arranged in descending magnitude, are given in Table II.

Drop Ratios . . . Limits for such investigation must at this stage of the development be chosen more or less arbitrarily; it is suggested that, for the present, locked currents up to 150% of present values at leading power factors that will under the conditions considered herein provide average drop ratios* between 1.00 and 1.50, be considered as justifying study by motor manufacturers.

Probable range of locked rotor cur-

* Drop ratio = $\frac{\text{starting voltage dip}}{\text{running voltage drop}}$

rents and power factors that will meet the voltage drop ratio range specified is shown in Fig 1. The average drop ratios of the four motors on the four transformer-secondary combinations are plotted for locked current ratios* of 1.0 and 1.5. It is seen that to attain average drop ratios between 1.00 and 1.50, leading power factors between about 53% and 63% are required if present values of locked rotor current can be retained; however, if locked rotor currents increase to 150% of present values, the power factor range is from about 43% to 50% leading. These are the considerations that lead to the first two recommendations given at the beginning of this paper.

Attainment of low leading power factor is not a simple matter of adding microfarads of capacity in series with one or both of the motor windings. Small microfarad ratings produce low leading power factors, but high microfarad ratings produce much higher leading and eventually lagging power factors. The reason for this is that the high microfarad values have such low capacitive reactance in proportion to the inductive reactance of the winding itself, that the circuit impedance is little affected by the addition of the capacitor.

Locked Rotor PF . . . Recommendation (1) proposes a motor having a locked rotor current of about the same magnitude as present design but having a locked rotor power factor of about 60% leading. It is evident that this motor will require a comparatively low resistance auxiliary winding. If the total locked rotor current has a power factor of 60% leading, then the auxiliary winding must have an even lower leading power factor which can be obtained only by decreased resistance. Thus, this motor will require a substantial percentage increase in volume of copper in the auxiliary winding. It should be pointed out, however, that since the size of copper wire used for the auxiliary winding is relatively small, the volume of copper can be increased several times without adding a great deal of copper weight.

It is apparent that the motor of recommendation (1) will be larger and more expensive than present day motors. Nevertheless, for reasons already indicated, its development by motor manufacturers is strongly urged.

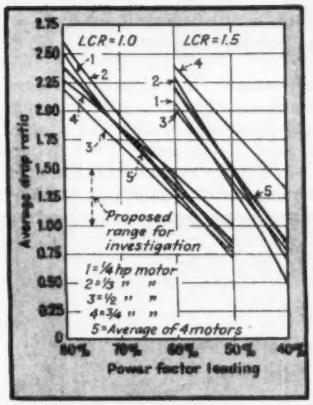


FIG 1—AVERAGE DROP RATIO is reduced by leading power factor of locked rotor currents. LCR is locked current ratio of proposed and present motors

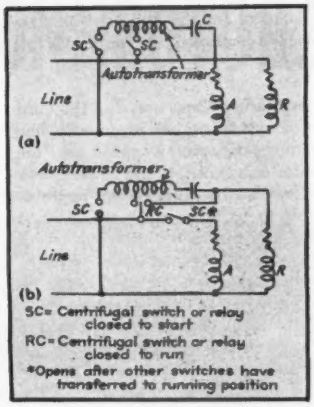

Autotransformer
Line
(a)
(b)
SC= Centrifugal switch or relay closed to start
RC= Centrifugal switch or relay closed to run
*Opens after other switches have transferred to running position

FIG 2—CONNECTIONS for motor with one winding and capacitor supplied by autotransformers: (a) Capacitor with auxiliary winding A, (b) running winding R

Autotransformer . . . Recommendation (2) proposes a motor having a locked rotor current up to 50% greater than present designs but having a locked rotor power factor of the order of 45% leading. This proposal involves the use of high voltage to supply either the auxiliary winding or the running winding during the starting period. Its chief advantage is that it permits the use of motor windings of about the same resistance and impedance as present day designs, and thus avoids the increased volume of copper in the auxiliary winding as discussed above. However, an autotransformer and suitable switching must of course be provided, as well as possibly some additional insulation. Circuit diagrams are suggested in Fig 2.

Low leading power factor needed in one of the windings during the starting period can be obtained with present winding impedance characteristics only with small capacitor microfarad ratings where the condensive reactance of the capacitor is several times the offsetting inductive reactance of the winding. However, the resultant impedance of the circuit is then so high that the current that 115 v can force through it becomes only a fraction of the desired value, and consequently starting torque is materially reduced. But, if 115 v can't produce enough current in the circuit, some higher voltage can. Hence the need for the autotransformer. This arrangement offers the further advantage that the leading power factor current in the circuit fed by the transformer will appear in the 115-v supply circuit multiplied by the ratio of transformation, thereby effecting a greater decrease in line power factor in the leading direction.

Effectiveness . . . In order to confirm the effectiveness of this type of starting arrangement, a split-phase motor was subjected to tests in the laboratory, in the course of which two values of high voltage were impressed on one of the motor windings with its series capacitor, the other winding being connected directly to the supply circuit, as in Fig 2. All tests were made with rotor locked and mechanically connected to a spring balance to measure locked torque at a one-foot radius. The equipment used was such potential transformers as happened to be on hand and ordinary motor starting capacitors available from a motor parts supply house and connected in the series-parallel arrangement required to keep voltage drops across individual capacitors at approximately rated value. In spite of lack of best

* Locked current ratio = $\frac{\text{locked rotor current of proposed arrangement}}{\text{locked rotor current of present motor}}$

equipment for the purpose, the tests readily confirmed the principles involved.

Line-Starting Capacitors . . . The third recommendation has to do with line starting capacitors applied at the motor terminals. As has already been indicated, the voltage dip improvement to be attained by this method in a function of the power factor of the capacitor. In the initial stages of this study, it was hoped that the inexpensive electrolytic capacitor now so widely used with capacitor-start motors would be satisfactory for this new application. This type of capacitor, however, has a power factor of 10% or more and as the study progressed it was found that its effectiveness lay mainly in the larger transformer and wire sizes. Consequently, the use of capacitors with lower power factors was examined, the study showing that, on the average, the shunt starting capacitor does not produce as good results as motors designed to meet the conditions mentioned above. For example, with a 1,500-μf shunt capacitor, average drop ratios for the four motors on the four transformer-secondary combinations were found to be:

Power factor of capacitor	Average drop ratio
.000	1.57
.035	1.88
.100	2.43

All of these drop ratios are beyond the upper limit of 1.50 suggested above. In view of these limitations, it is apparent that higher drop ratios must be considered if starting capacitors are to be used.

Advantages . . . In spite of these limitations, the line starting capacitor may find a field of usefulness because of these advantages:

1. It might be made available as a separate device, with its own auxiliary switching equipment, all arranged in one package for installation close to the terminals of an existing motor whose starting flicker must be corrected.

2. It does not involve redesign of present-day motors.

3. It might serve as a somewhat less desirable substitute for the new motor designs already proposed in event that careful consideration shows them to have no economic future.

Suggested Drop Ratios . . . Consequently, for the present, it is suggested that motor manufacturers give consideration to line starting capacitors designed to give average drop ratios of 1.50 to 2.00. It appears that three alternatives in the application of line starting capacitors are possible: (A) A shunt capacitor connected across the motor terminals; (B) a series capacitor - autotransformer combination with the capacitor on the line side of transformer; and (C) a series capacitor-autotransformer combination with the capacitor on the motor side of the autotransformer. These arrangements can be so proportioned as to give identical results insofar as voltage dip improvement and drop ratios are concerned (assuming a "perfect" autotransformer). Likewise, although microfarad ratings are different in the three arrangements, capacitor kva requirements are identical. The straight series capacitor without an autotransformer has no application within the average drop ratio range of 1.50 to 2.00 proposed above.

Definite capacitor requirements in meeting the proposed drop ratio range are shown in Fig 3. It is seen that capacitor power factors of less than 4% are necessary, with microfarad ratings ranging as follows:

Arrangement of Capacitor	Rating, Microfarads
(A)	1,000-3,000
(B)	760-1,830
(C)	180- 870

where arrangement (A) is shunt capacitor across motor; (B) is series capacitor-autotransformer, with capacitor on line side of transformer; (C) is same as (B) but with capacitor on motor side of transformer.

These are the considerations that lead to the third recommendation given at the beginning of this paper.

Branch Fuses . . . Suggestions for increasing motor locked rotor currents naturally require a review of the time-current characteristics of branch circuit protective devices. For this purpose, use has been made of the recently published report of the AEIC-EEI Joint Committee on Branch Circuit Protection, and significant values of locked rotor currents of combinations discussed herein have been analyzed in connection with fuse time-current characteristics shown in that report.

The GI fuse proposed by the joint committee has, for excellent reasons as shown in its report, somewhat faster time-current characteristics that the H14 and accordingly does not cover the full range of conditions, the discrepancies being greater in those arrangements involving shunt starting capacitors. This is a further advantage of motor designs proposed herein in recommendations (1) and (2), which are also superior from the point of view of starting voltage dip.

Should leading power factor motor starting become a reality, particularly with shunt capacitors, the characteristics of branch circuit protective devices may become a limiting factor and further study and coordination will be necessary.

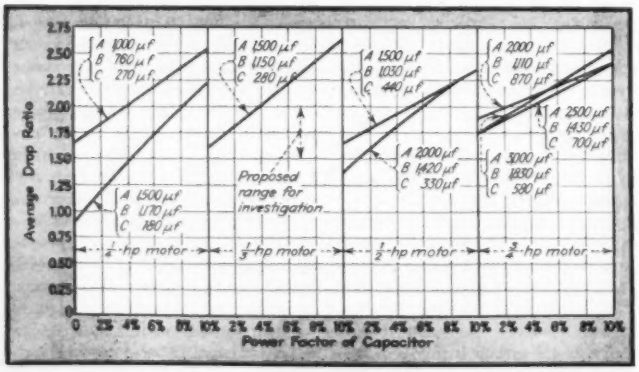
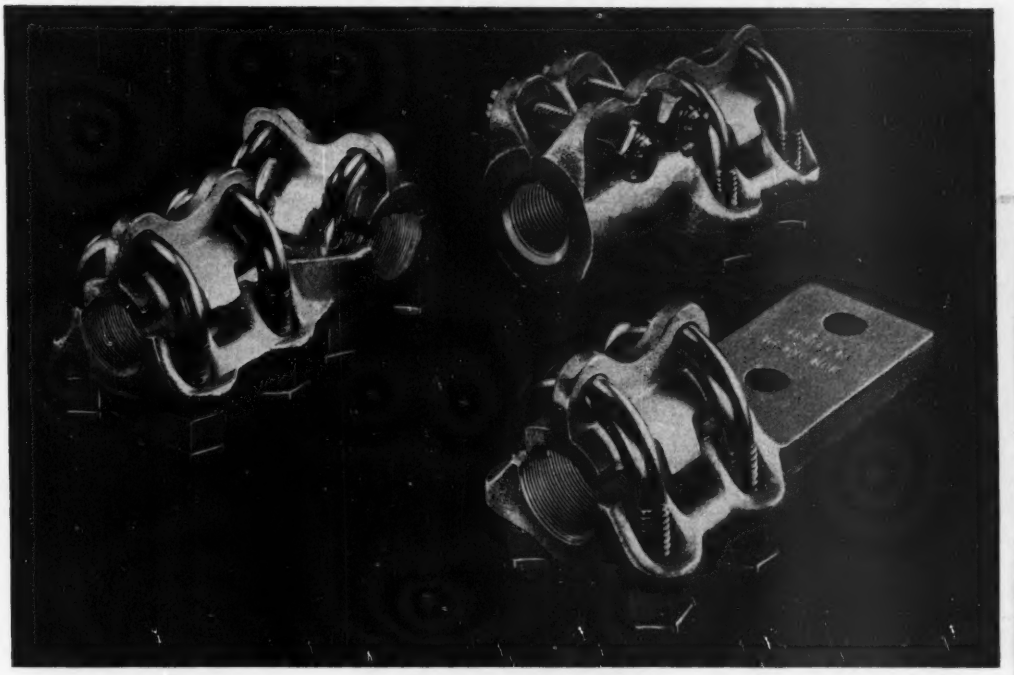


FIG 3—REDUCTION in average drop ratio is possible if line starting capacitors are used with present motors. Letters A, B, and C refer to shunt and series capacitor arrangements as outlined in text under paragraph "Suggested Drop Ratios"

SIMPLIFIED LINE OF CONNECTORS
cuts inventories, reduces costs!



5 G-E POWER CONNECTORS
handle 22 conductor sizes — cable, tube or rod!

When you standardize on G-E power connectors, you stock fewer sizes. With terminal connectors, for instance (lower right, above), only 5 sizes are required to handle all 22 conductor sizes between 1/0 and 1¼" IPS.

This simplified line cuts inventory problems. Less time is lost in finding the right connectors and in ordering new supplies. That means reduced costs.

G-E power connectors give permanent, high-conductivity joints. Serrated contact surfaces grip firmly. Silver plating eliminates oxidation problems. And the interlocking side construction on all Class A-2 and A-1 connectors confines all strands of the cable —makes possible a neater, more positive connection.

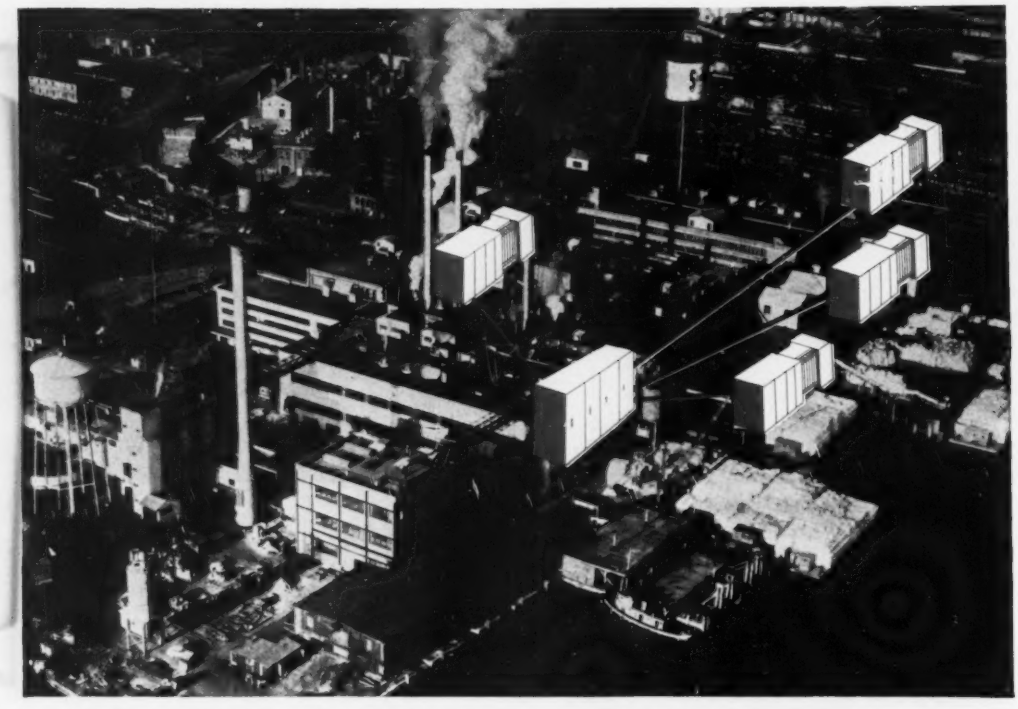
There's a wide range of types—straight, tee, block, angle, parallel, expansion, ground, and many others. Why not place a trial order with your G-E sales representative? Write for Bulletin GEC-400—it contains 44 pages of valuable connector information. *Apparatus Dept., Section 856-56, General Electric Co., Schenectady 5, N. Y.*

GENERAL ELECTRIC

856-56

Load-center distribution saves 172 tons of copper conductors

Will also permit *doubling* present electrical capacity of paper plant with no major changes

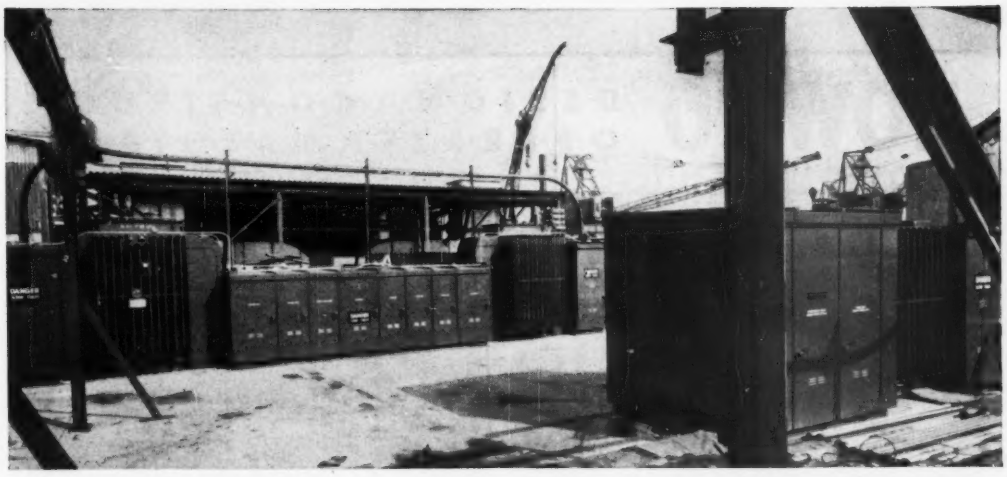


All power formerly went through a main switchboard at the company's power station, and then to various buildings over large, low-voltage cables in 8-inch conduits. Total length of the low-voltage runs was about 4400 feet. This system has now been replaced by load centers, as shown above. Approximately 172 tons of copper conductors were saved.

Vital floor space has been gained by locating the load-center units on roofs of the various buildings served. Voltage has been improved, as has the flexibility of the entire power distribution system. Finally, provision has been made for further expansion wherever required. Actually, foundations for several additional load-center units were put in at the time—and in some cases, all that is needed to provide more power is to convert single-ended to double-ended units.

321-71

GENERAL ELECTRIC



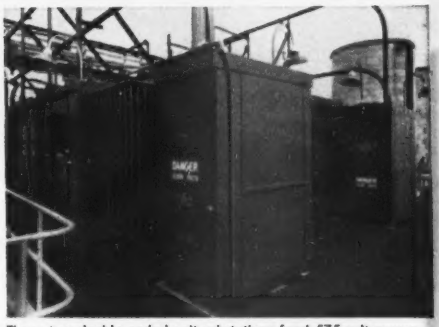
Two load centers on the roof of one building serve one of the paper machines. Double-ended unit in background steps 13,200 volts down to 2300. Single-ended unit in foreground steps the high voltage down to 575. Addition of a transformer and airswitch to this low-voltage unit will double its capacity. Space is available to install a second unit if needed.

Scott Paper Company of Chester, Penna,. was distributing something over 10,000 kw of power throughout its plant at 575 volts.

An expansion program at the company raised power demands. It became necessary to increase, considerably, the tonnage of low-voltage cable in service—or to change the power-distribution system completely.

Calculations showed that if the 575-volt system were continued, a total of 180 *tons* of copper would be needed in the main secondary runs. With a load-center system, these could be replaced with three-phase 400 mcm 13,200-volt cable—containing only eight tons of copper, or *1/23rd as much.*

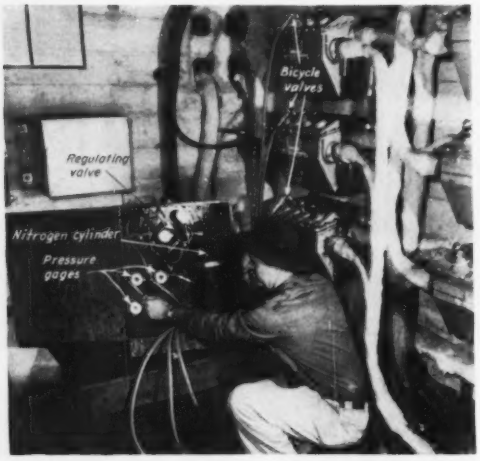
The load-center system was adopted and has now been installed, using General Electric equipment throughout. Besides the big saving in copper, system capacity can be doubled at any future time with no further rearrangement of conductors, switchgear or transformers. *General Electric Company, Schenectady 5, New York.*



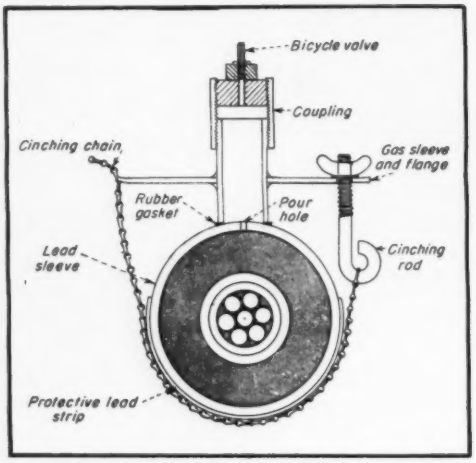
These two double-ended unit substations feed 575-volt power to the pulp-preparation units. A foundation has already been provided, to the right of these units, for another double-ended substation if and when needed.

GONE! These 8-inch conduits were used between buildings when power was distributed at 575 volts—and more were needed. They have now all been ripped out, and replaced by single 4-inch conduits carrying three-phase 13,200-volt cables.

HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN



DRY NITROGEN in expansion chamber reduces explosion hazards. Regulating valve on high-pressure nitrogen bottle feeds low-pressure gas through hose to bicycle valve mounted in one plug of chamber top. LP nitrogen is allowed to flow during switching operations, prohibiting air entering the box



TESTING SPLICES for leaks is an extra application of this equipment. Gas sleeve and flange are clamped against the lead sleeve, sealed with a rubber gasket, and nitrogen at 15 psi applied to sleeve through valve and pour hole. Leaks are shown by bubbles in liquid soap swabbed on the splice

Nitrogen Lessens Junction Box Explosion Hazard

C. B. ANDERSON
Engineering Department
California Electric Power Co
Riverside, Calif.

Dry nitrogen gas under controlled pressure has helped to eliminate an explosion hazard, simplified maintenance, and improved the service of underground junction boxes of California Electric Power Co. Nitrogen displaces air in the enclosed expansion chamber above the oil level of the oil-filled boxes, eliminating moisture and oxygen which in the past have been factors in causing flashovers and explosions.

Top of each junction box is equipped with four plugs, one of which has a bicycle-type valve mounted in it. Dry nitrogen is fed to this valve from a small portable high pressure tank equipped with a pressure regulator. A Y-connection provides for a low pressure gage in the line.

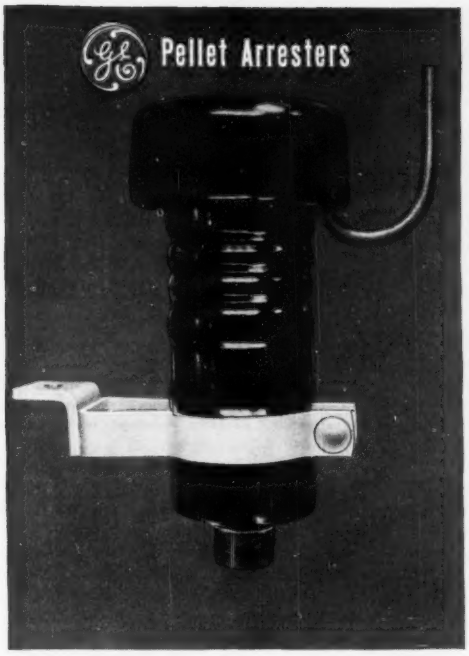
During switching operations, dry nitrogen continuously flows through the box. It enters the box under low pressure at the valve and exhausts at the plug opening over the contact bayonet which is to be removed or inserted. When the box is to be sealed, the chamber is completely saturated with nitrogen, the plug is screwed in tight, and the pressure raised slightly above atmospheric, then the hose is disconnected.

For routine leakage tests, the nitrogen is turned on to remove any air from the hose, then the connection is made to the valve, and the pressure read on the gauge. A simple relation between manhole temperature and pressure in the box supplies a correction factor that is applied to the gage reading. This gives a direct comparison and the pressure loss over any reasonable period.

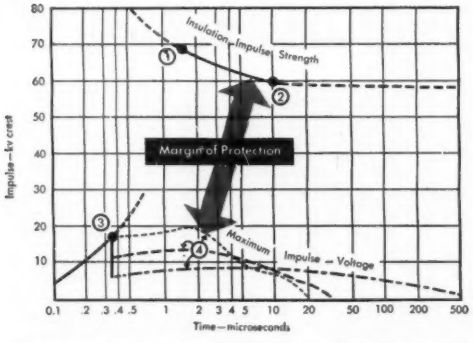
For convenience, the portable equipment was experimentally assembled with three separate gages and hoses supplied from a common nitrogen bottle so all three junction boxes on a three-phase circuit can be handled simultaneously. The complete unit is carried on the operator's truck, and used to service all boxes. It is also used to test splices and potheads for leaks, and to provide freedom from contamination when sampling or replenishing switch oil. Illustration above shows set-up for leak testing.

How to Support Fuel Oil Supply Lines

Fuel is supplied to two 15,000-bbl storage tanks at Boston Edison's Mystic generating station through a one-mile pipe line direct from an oil refinery, as well as by alternate means. About one-third of this 8-in. line was run underground because of street location, another third on poles, and the



THE G-E PELLET ARRESTER is also unequalled in durability—the only distribution arrester with series gaps sealed in dry, inert nitrogen. Gap electrodes stay bright as new. The Pellets, themselves, are unaffected by service moisture.



THIS GRAPH was made from actual volt-time and ampere-time oscillograms, and from AIEE standard test data. The demonstrated impulse strength of 2400-volt distribution transformer insulation is represented by the curve passing through: (1) the minimum impulse strength on an AIEE standard chopped wave test, and (2) the minimum impulse strength on an AIEE standard full wave test. The impulse voltage allowed by a 3-kv General Electric Pellet Arrester is determined by (3) the impulse sparkover voltage of the arrester on the AIEE standard test wave, and (4) the IR drop across the arrester to ground with (top line) a 65,000 ampere discharge—(middle line) a 20,000 ampere discharge —and (bottom line) a 1500 ampere long duration discharge. The arrows show the unequalled margin of safety.

No other distribution arrester protects so well

HERE'S THE EVIDENCE. The graph below, from actual volt-time and ampere-time oscillograms, shows the unequalled margin of safety that a 3-kv General Electric Pellet Arrester gives a 2400-volt distribution transformer. Higher rated arresters, protecting higher-voltage transformers, similarly show this unequalled margin of protection.

HERE'S THE REASON. This extra protection results from a combination of low sparkover voltage *and* exceptionally low IR drop. Whether lightning currents are high or low, with durations long or short, *no other distribution arrester holds voltages to such low levels.*

HERE'S YOUR CUE. The Pellet is a valve-type arrester for universal use on urban, rural, or industrial systems. It is available in ratings of 1 kv to 15 kv inclusive. This arrester has been *the* quality-standard for over 25 years—it's your cue for maximum protection. For further information contact your G-E representative or your authorized G-E agent.

Apparatus Department,
General Electric Company,
Schenectady 5, N. Y.

GENERAL ELECTRIC

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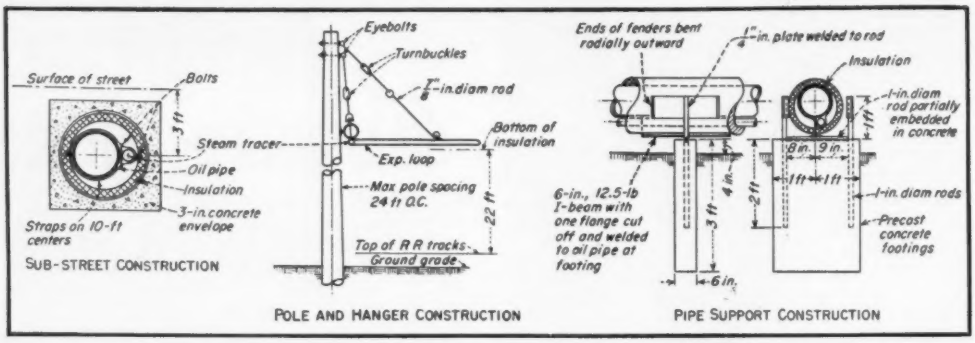


CONSTRUCTION DETAILS of supports for oil pipe and steam tracer line are varied to carry line below streets and sidewalks, overhead, and short distance above the ground. In sub-sidewalk construction, concrete envelope is eliminated

remainder on concrete piers a small distance above grade.

According to David H. Little of Boston Edison, it was not only less costly to build the line close to the surface on the refinery property but also it provided maximum accessibility. Underground construction was necessary to permit crossing of a public highway. The section carried on wooden poles traverses an area with a muddy soil. In this area, construction allows compensation in case of slight settling in the future,

Specifications detailed above were followed in meeting these three construction variations. Insulation enclosing the oil pipe and steam tracer consists of 2-in. asbestos sponge felt, with membrane water-proofing. Insulation joints are lapped for 2 in. with hot asphalt and then the entire surface is so coated. Expansion bends or joints were provided only in the 2-in. steam tracer, because the oil line was considered sufficiently flexible. Wooden support poles were placed alternately on either side of the line to help brace it.

The storage tanks, built during the recent conversion of the 150,000-kw station to oil firing, were built on cast-in-place concrete pile foundations. Piles were necessary because the terrain was incapable of supporting even one ton of load per square foot.

Mount Digger On Turntable For Flexible Operation

S. H. POLLOCK
Assistant Superintendent
Overhead Dept
Kansas City Power and Light Co
Kansas City, Mo.

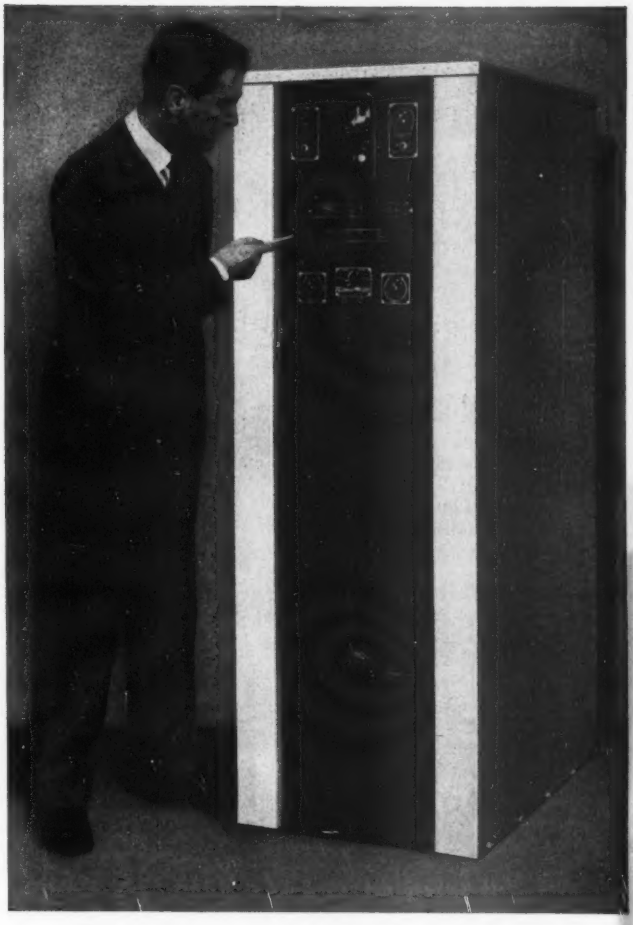
Flexibility in hole digging operations by Kansas City Power and Light Co crews is accomplished by use of a truck-mounted, rotating digger which can dig a hole anywhere in a 240-deg arc around the back or either side of the truck. Also included is a two-foot horizontal adjustment which allows easy and accurate placement of the auger over the pole location. The turntable horizonal adjustment makes it possible to drill holes along the street without driving over the curb and with a minimum of street obstruction. Management likes the new digger because it provides economical operation, the construction superintendent because he is getting his work done faster, and the crews because they no longer have to dig holes by hand.

The machine, and separate engine

TURNTABLE swings digger through 240-deg arc; 2-ft slide adjustment permits operator to set auger accurately. Holes can be dug on narrow city streets without need of backing over curbs and with minimum obstruction to traffic

New G-E three-phase INDUCTROLS

(dry-type induction voltage regulators)



- Require less floor space than any 3-phase regulators previously available.
- For circuits up to 500 amp, 600 volts and below.
- Will help keep production up—by keeping voltage up.

A new standard line of three-phase "Inductrol" voltage regulators has been announced by General Electric. These regulators have a three-phase winding on a single core—and thus require less floor space than the Triplex assembly which consists of three single-phase regulators on a single base.

These new regulators are completely self-contained, and include a power supply for both control panel and operating motor. They are furnished in attractively styled all-steel cabinets, with all live parts completely enclosed. Ratings up to 300 load amperes are self-cooled. Higher ratings are forced-air cooled. All are 19 x 27 x 51 inches high or 22 x 31 x 65 inches high.

Poor voltage means sluggish performance of electric equipment—and reduced output. To be sure you are getting the motor performance and the lamp brilliance you pay for, use voltage regulators. For advice on how, when and where to apply them, contact your G-E sales representative or authorized agent. *General Electric Co., Schenectady 5, New York.*

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GENERAL ELECTRIC

which drives it, are mounted on a 2½-ton truck equipped with dual rear axles.

The digging bar folds over the cab for a road clearance of 11 ft. Hydraulic controls are used to erect the digging bar, swing the machine, and regulate horizontal motion. These controls also can level the auger so that the truck need not be level. Crowding, retracting and turning of the auger are all done by direct drive through clutch control. The auger can dig at up to a 45-deg angle, so that anchor holes can be put down along with pole holes.

Four different sized augers—8 in., 18 in., 24 in., and 36 in.—are carried as standard equipment. One of the worst conditions in the territory is loose rocks, buried in soft clay. The digger pulls them right out, some of them up to 12 in. in diam.

The digger is also equipped with a winch line which enables it to set the poles in holes. Poles in sizes up to 50-ft, class 5 have been set. A two-man crew is used—the machine operator, and a truck driver who assists the operator when necessary.

Rope Testing Set-up Reduces Labor, Improves Results

Since ropes used for power system operation often come in contact with energized wires, they are tested to detect conducting materials. Various methods of making such tests have been devised.

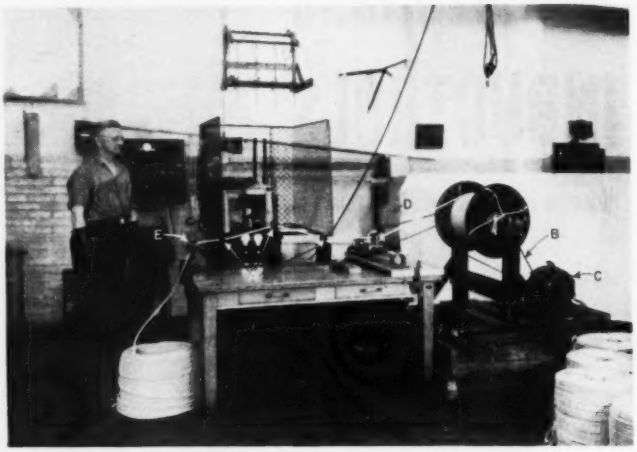
In the laboratory of the Public Service Co of Northern Illinois, the rope is wound from the factory coil to a take-up reel through three brass guides, A, which are in line and spaced one foot between inner edges. The center ferrule is one or two inches higher than the other two and is energized at 45,000 v above ground. The other two ferrules are grounded to guard against current being conducted to the reel or coil.

The take-up reel is turned with a ½-in. V-belt, B, which in turn is pulled by a 400-rpm motor, C, controlled by a foot switch.

Motor operation eliminated most of the work involved in testing rope but it was difficult for the operator to lay the turns on the reel well enough so that the rope could be payed out at the s'oreroom without kinking or snarling. Consequently, a device which lays the individual turns in place was developed by G. J. Beckel of the testing department.

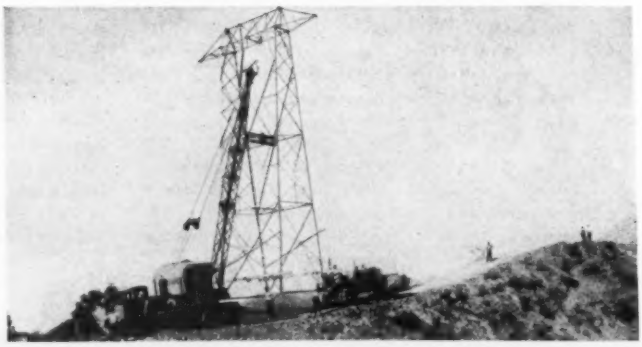
The rope is threaded through an eye, D, which travels back and forth across the reel at a uniform rate after the fashion of a fishing reel level wind. Multiple pulleys on the shaft allow changes in rate of travel to facilitate making a tight coil regardless of the size of rope. A spring-restrained brake, E, just ahead of the first guide, further aids in making a tight coil.

This device reduces the labor involved and improves the quality of the tested rope coil. Also, the operator may stand far behind the reel and view the entire procedure—increasing safety of the operation.

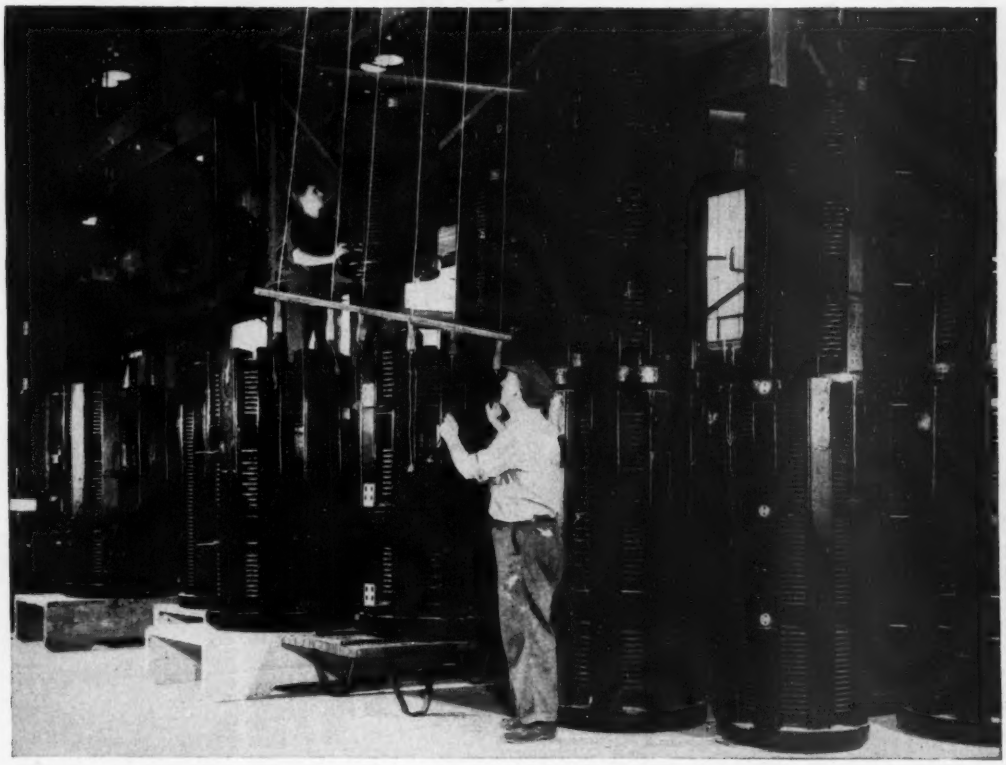


INDIVIDUAL TURNS of rope are laid in place by this device. Rope is wound through brass guides (A) to take-up reel turned by V-belt drive (B) and motor (C). Eye (D) travels back and forth across reel; spring-restrained brake (E) tightens coil

Mobile Crane Moves 110-kv Towers



RELOCATION of two 110-kv transmission towers on the Salt River Power District system in Arizona was done in four days without disassembly and reassembly of the towers. The two 60-ft towers were cut free of their foundations and, supported from the 40-ft boom of a mobile crane, were moved about 2,000 ft to new foundations. A tractor was used to supplement mobility of the crane on steeper grades



Newest G.E. cast-in-concrete reactors are sturdier, more dependable, as a result of glass insulation and transposed conductors.

Glass Insulation increases life of cast-in-concrete reactors

AVOID EXPENSIVE CONCRETE VAULTS! Metal housings for reactors minimize stray current and electrical losses, and provide additional protection against possible damage from external causes. These housings can be matched to G-E metal-clad switchgear installations.

Prolonged operation of reactors at extremely high temperatures can cause rapid aging of conductor insulation. To overcome this, General Electric is now using glass insulation, on air-core current-limiting reactors. This new insulation, unaffected by moisture, will not deteriorate even at high overloads. Free of metallic impurities found in most asbestos tapes, it provides greater dielectric protection against turn-to-turn short circuits than any other type of wound insulation used in reactor manufacture.

Transposed Cable—Another Exclusive Advantage!

The cable used in G-E reactors consists of continually transposed conductors which produce lower losses and greater short-circuit strength.

These features make the General Electric reactor sturdier and more dependable. For full information on the application of cast-in-concrete reactors, get in touch with the nearest G-E Apparatus Sales Office, or write to General Electric Company, Schenectady 5, New York.

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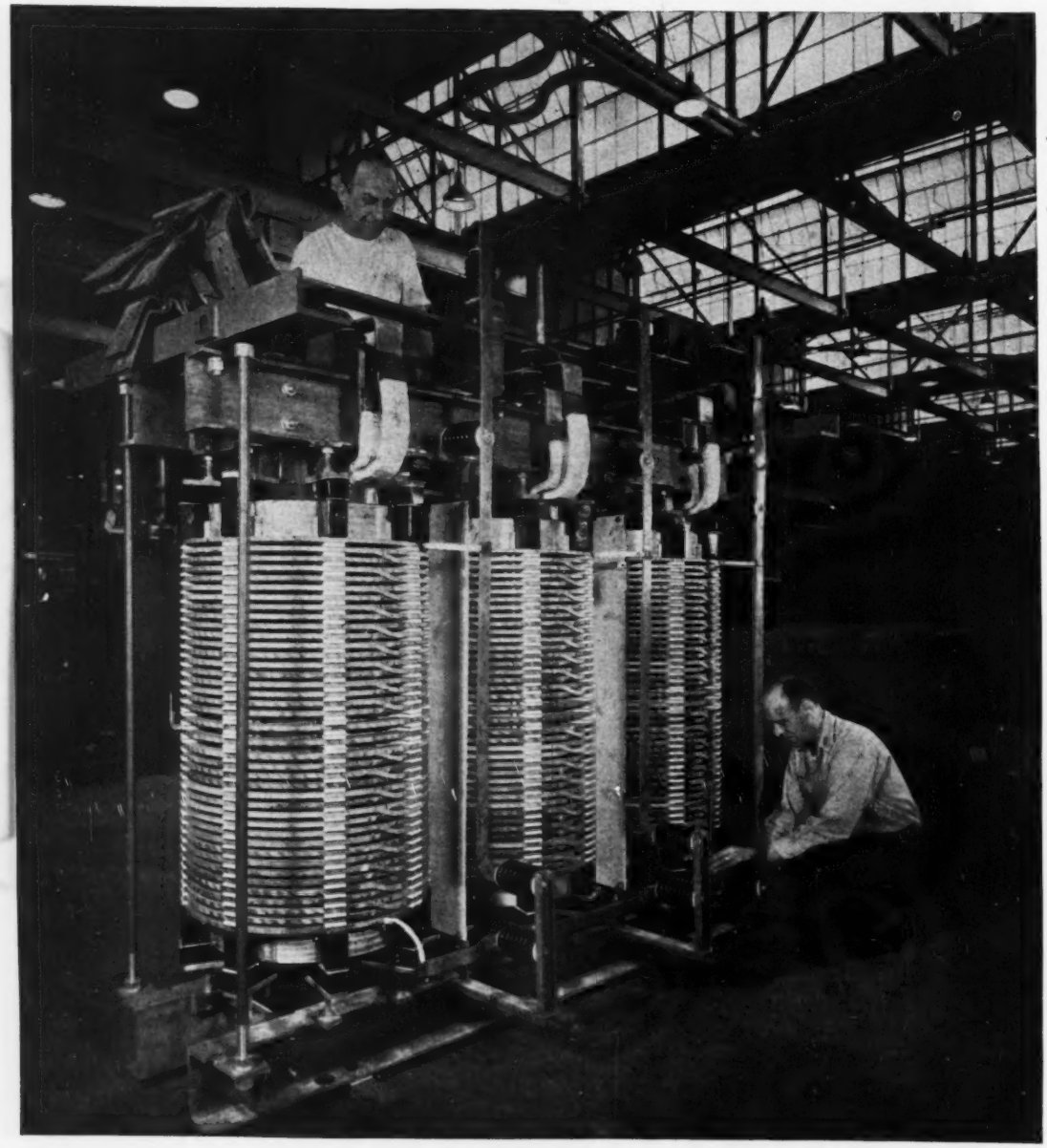
GENERAL ELECTRIC

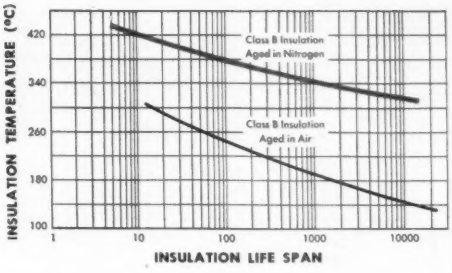
New G-E Development Results



Typical core-and-coil assembly of a 1250-kva sealed dry-type transformer to be installed in an outdoor substation.

in 8% Price Reduction on Sealed Dry-Type Transformers

SAVINGS MADE POSSIBLE THROUGH RESEARCH ON CLASS B INSULATION IN NITROGEN



Last year General Electric announced sealed dry-type transformers—using Class "H" inorganic insulation in hermetically sealed nitrogen-filled tanks.

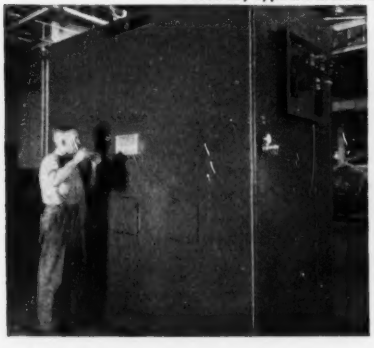
Now, a new development opens the way to real economies. G-E engineers—after extensive tests—have found that Class "B" insulation ***sealed in nitrogen*** can be operated at temperatures previously thought practical only with the more expensive Class "H" insulation—and with a life expectancy ***equal to or greater than*** Class "B" insulation operated at lower values in conventional ventilated construction.

The use of Class B insulation permits an immediate 8% reduction in prices. Previous sealed dry-type transformers with Class H insulation were priced 20% higher than conventional open dry-type units, but the new Class B insulated units are priced only 10% higher.

Ratings of the sealed dry-type transformers extend through 1500 kva and 15,000 volts. Units are also available with G-E metalclad switchgear for load-center installations, or with network protector and high-voltage switch as a completely equipped network unit.

For details, contact your nearest G-E Apparatus Sales Office or write Apparatus Dept., General Electric Company, Schenectady, N. Y.

Sealed dry-type transformers for outdoor substation (left) and for underground network unit.



FOR INDOOR, OUTDOOR OR UNDERGROUND SERVICE

Sealed dry-type units like those above have three main advantages: (1) Nitrogen-filled tanks—no oil to maintain. (2) Smooth exteriors—no radiators to complicate installation, no tubes to raise painting costs. (3) Hermetically sealed. Welded tanks have metal-to-glass sealed bushings—coils need no cleaning or drying.

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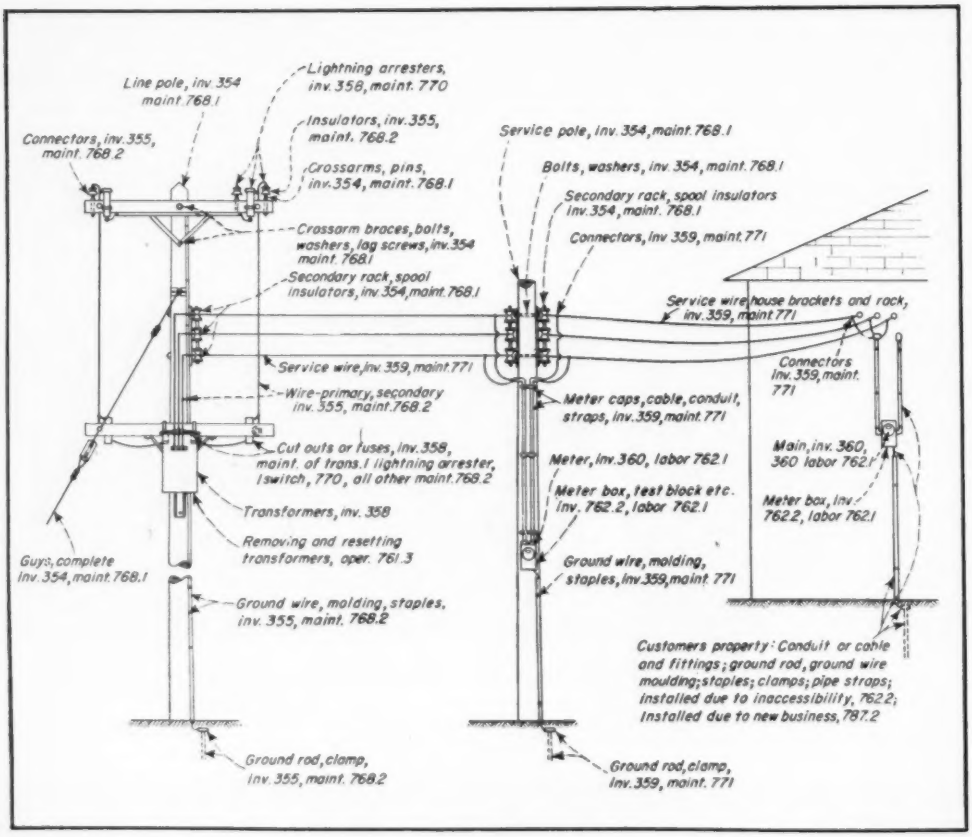
GENERAL ELECTRIC

Accounting Chart Provides Assignment For Distribution and Service Charges

A guide for accounting, engineering, stockroom, and distribution personnel to inventory and maintenance accounts. Unless otherwise specified, labor and material are charged to same account. Federal Power Commission account numbers are indicated. This chart was designed primarily for accounting purposes by Central Power & Light Co, Corpus Christi, Texas


Line pole, inv. 354 maint. 768.1
Lightning arresters, inv. 358, maint. 770
Connectors, inv. 355, maint. 768.2
Insulators, inv. 355, maint. 768.2
Crossarms, pins, inv. 354, maint. 768.1
Crossarm braces, bolts, washers, lag screws, inv. 354 maint. 768.1
Secondary rack, spool insulators, inv. 354, maint. 768.1
Service wire, inv. 359, maint. 771
Wire-primary, secondary inv. 355, maint. 768.2
Cut outs or fuses, inv. 358, maint. of trans. 1 lightning arrester, 1 switch, 770, all other maint. 768.2
Transformers, inv. 358
Removing and resetting transformers, oper. 761.3
Guys, complete Inv. 354, maint. 768.1
Ground wire, molding, staples, inv. 355, maint. 768.2
Ground rod, clamp, inv. 355, maint. 768.2
Service pole, inv. 354, maint. 768.1
Bolts, washers, inv. 354, maint. 768.1
Secondary rack, spool insulators Inv. 354, maint. 768.1
Connectors, Inv 359, maint. 771
Service wire house brackets and rack, inv. 359, maint. 771
Connectors Inv. 359, maint. 771
Meter caps, cable, conduit, straps, inv. 359, maint. 771
Meter, inv. 360, labor 762.1
Main, inv. 360, 360 labor 762.1
Meter box, test block etc. Inv. 762.2, labor 762.1
Meter box, Inv. 762.2, labor 762.1
Ground wire, molding, staples, Inv. 359, maint. 771
Customers property: Conduit or cable and fittings; ground rod, ground wire moulding; staples; clamps; pipe straps; installed due to inaccessibility, 762.2; Installed due to new business, 787.2
Ground rod, clamp, Inv. 359, maint. 771

Electric hands on hot spots warn of overheat danger

For Temperatures of:

- Generator Stator
- Generator Field
- Hydrogen Cooler
- Exciter
- Bearing Oil
- Bearing Metal
- Transformers
- Cables

When any overload, whether emergency or planned, pushes equipment past safe ratings, L&N instruments in thousands of plants warn operators against overheat damage.

Temperature Detectors. For temperatures of generator and synchronous condenser stators, motors and transformers, Thermohms —A.I.E.E. standard resistance thermometer elements—are built into the equipment during manufacture. Other types and sizes of Thermohms are mounted in cooling ducts, oil and water lines. The numerous L&N thermocouples for power equipment include a flexible, small-diameter design for bearings.

Instruments. Newest model is a Speedomax which checks through 160 separate temperature points in less than 11 minutes. This instrument records, indicates and signals in any desired combination; centralizes data and greatly reduces the labor involved in routine temperature monitoring. Other Speedomax models cover up to 16 points, at a rate of one every four seconds. Micromax instruments record up to 16 points, at a rate of one per minute. Single point Micromax is supplied for rotor temperature, with special calibration for the individual generator. Where automatic recording is not required, manual or automatic panel indicators can handle up to 96 Thermohms or 126 thermocouples.

All models come in standard ranges for power plant temperatures. Recorders can operate signals and alarms when temperature limits are reached, as required for the operating needs of the individual plant.

L&N Engineering Service. Through several decades of intensive experience with power plant applications, our staff of specialized engineers has worked with many major utilities on instrument problems. An L&N man will be glad to study your applications: just write to our nearest office. For a copy of our catalog, write to Leeds & Northrup Company, 4938 Stenton Avenue, Philadelphia 44, Pa.

LEEDS NORTHRUP

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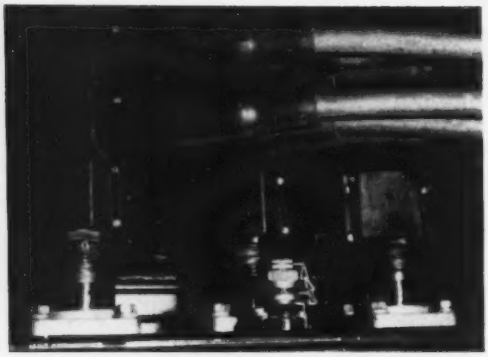
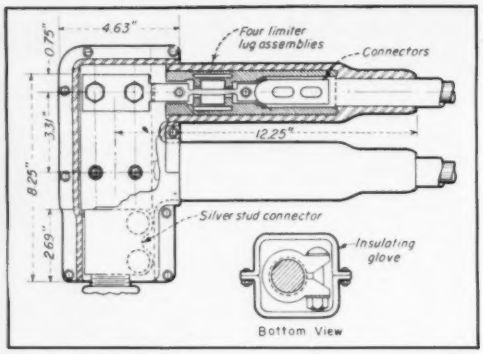


SPECIAL CONNECTORS for underground network terminals are designed to meet the requirements of minimum head room



CONNECTOR ASSEMBLIES accommodate 1½-in. studs, 500-Mcm feeder cables and limiters, and insulate live parts

Network Terminal Cuts Underground Installation Costs

When a multiple connector was required on the Union Electric Co distribution network, for installation where minimum head room was available, a special type was designed. It was necessary to accommodate the 1½-in. transformer bushing studs and four 500-Mcm cables. Also, the connectors had to provide for installation of limiters in the 500-Mcm feeder cables. For safety reasons the entire assembly had to be insulated to prevent accidental contact with live parts.

Solution was a special stud connector which clamped onto the stud and had a flat bar tongue. Limiter lugs two high and two wide can be bolted to this tongue, thus keeping headroom to a minimum. The entire assembly is enclosed in a special molded rubber glove which is bolted together, thus preventing accidental contact with the live connector. The assembly is not watertight because there is no possibility of flooding the vault. Overall height of the connection is approximately 9½ in., which includes 2-11/16 in. of stud height.

Installed in a sidewalk vault these assemblies have been subjected to cooling water spray but no difficulty has been encountered. In addition, this method of providing multiple terminals saves the time which would have been required for taping connections and for digging extra vault space.

Spraying Cabinet Speeds Transformer Painting

J. M. DAVIS
L. A. BUCKLEW
Meter and Service Dept
The Ohio Power Co
Coshocton, Ohio

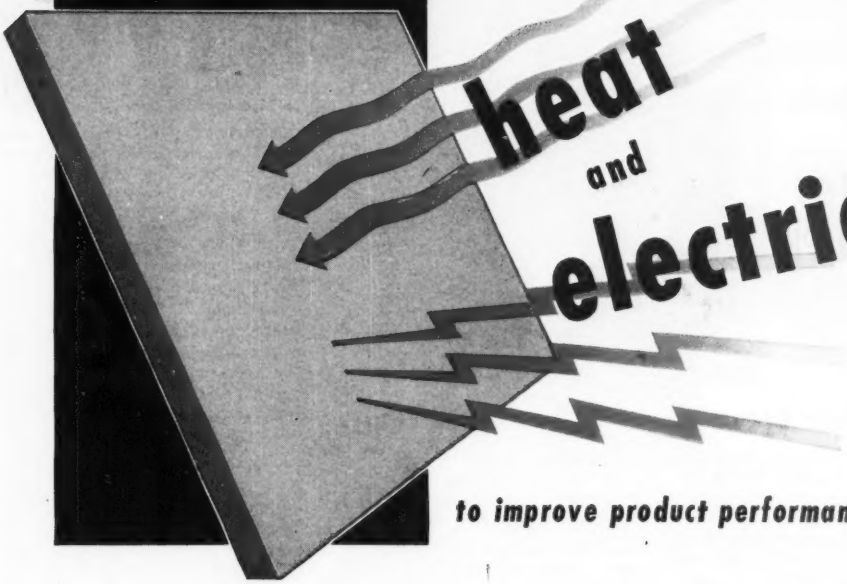
Painting of instrument current transformers is being expedited by using a simple spraying cabinet and transformer support. Both of the items were made at negligible expense. Many of these transformers can now be painted in the time formerly required to paint just one using the old brush method.

Either round or square-case current transformers may be sprayed with this equipment. All of the transformer except the terminal end is sprayed. Bushing end is brush-painted to avoid coating the insulators, although shields might be developed to permit spraying even the terminal ends of the cases.

The spraying booth was made of

SPRAYING CURRENT TRANSFORMERS in booth built of scrap material is much quicker than hand painting. Bushing and leads are shielded inside wood support

NEW C-D Silicone Dilecto withstands an inferno of heat and electricity



to improve product performance for you!

There are three new grades of C-D Dilecto* that can withstand temperatures as high as 250°C. They are chemically inert, silicone-glass laminated plastics that offer exceptionally high heat resistance and good arc resistance, extra strength, and positive moisture resistance! At Continental-Diamond we've literally lived and worked with Silicone Dilecto—perfecting it to a point where we believe it can be highly useful in helping to solve your production problems — and improve product performance.

your partner in producing better products

And this remarkable plastic is but one of many in the C-D family. They provide practical combinations of mechanical, electrical, and chemical properties—structural strength, light weight, positive moisture, heat and corrosion resistance. In hundreds of plants, C-D Plastics—Fibre, Vulcoid, Dilecto, Celoron, and Micabond—offer proof that it pays to see C-D first in your search for the right plastic for the job. For interesting, useful information on Silicone Dilecto, and other C-D high strength plastics, call or write your nearest C-D office, soon.

*Dilecto GB—112—S
Dilecto GB—128—S
Dilecto GB—261—S

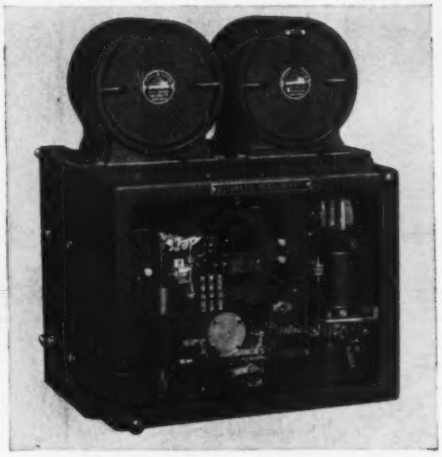
DE-2-49

BRANCH OFFICES: NEW YORK 17 • CLEVELAND 14 • CHICAGO 11 • SPARTANBURG, S. C. • SALES OFFICES IN PRINCIPAL CITIES
WEST COAST REPRESENTATIVE: MARWOOD LTD., SAN FRANCISCO 3 • IN CANADA: DIAMOND STATE FIBRE CO. OF CANADA, LTD., TORONTO 8

Continental-Diamond FIBRE COMPANY

Established 1895 . . . Manufacturers of Laminated Plastics since 1911 — NEWARK 15 DELAWARE

Saves Manpower—Automatically Detects, Records Line Faults



TYPE PM-13 OSCILLOGRAPH

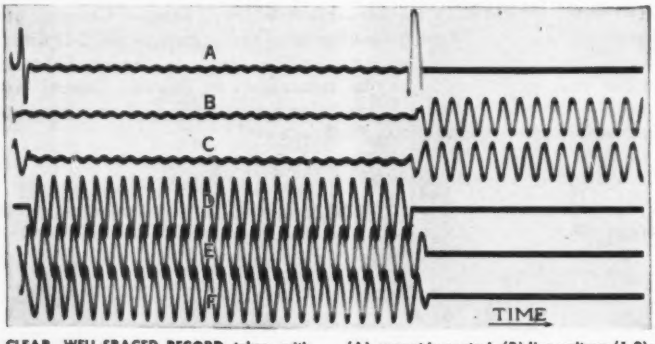
Fewer Repair Crews Required to Locate Faults

During the manpower shortages ahead, General Electric's PM-13 oscillograph can save you many valuable man-hours. It automatically provides a detailed, graphic record of how your power system behaves under any fault condition.

REQUIRES NO OPERATOR—It starts (in 1/240 second), records entire disturbance time, and stops after fault has been cleared. Operation can be initiated by any device that will break a circuit, so it can be used at an unattended station. Makes as many as 100 oscillograms without intermediate attention.

REDUCES LOSS OF SERVICE—Faults are more quickly located for repair. Minor faults can also be detected before they cause major damage, thus preventing future outages.

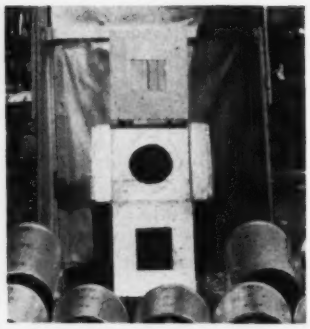
For more information, see your G-E representative or write for Bulletin GEC-396. *General Electric Company, Schenectady 5, N. Y.*



CLEAR, WELL-SPACED RECORD taken with PM-13 of 3-phase-to-neutral short circuit—system frequency, 60 cycles. Record shows (A) current in neutral; (B) line voltage (1-2); (C) line voltage (2-3); (D) line current (1); (E) line current (2); and (F) line current (3).

GENERAL ELECTRIC

602-205



CUT-OUT TOPS are hinged so that square or round tanks are accommodated in case, tilted forward above

used range crates. To support the transformers and protect insulating terminals while spraying, use is made of a standard packing case having a round hole cut in the upper end. Hinged on each side of the top are two sections containing square holes, one larger than the other. (Supporting case is tilted forward in the photo above.) Either hinged section can be folded over the permanent top containing the round hole. Either round or square-case current transformers may be set on one of the sections with all bushings and primary leads down inside the cabinet unexposed to paint spray.

When spraying the cases, the nameplates are also sprayed, but wiped with a rag as soon as painted. This procedure makes all name-plate markings stand out distinctly. After spraying, the tank is moved by hand, using gloves, and touched up by brush.

The spraying booth and transformer support were made by meter department men in a couple of hours. Any standard spraying equipment may be utilized.

Load Checks Speeded With New Ammeter

One large utility company in the middle west is speeding load checks by using a live-line ammeter. (See description on page 160, "Electrical World," Oct. 9, 1950.) This instrument can be placed over the conductor to be measured with a twist of the wrist from hot-stick distance. The angle at which it fits on the hot-stick is such that it can be read by the lineman or troubleman at stick-length. This frequently reduces con-

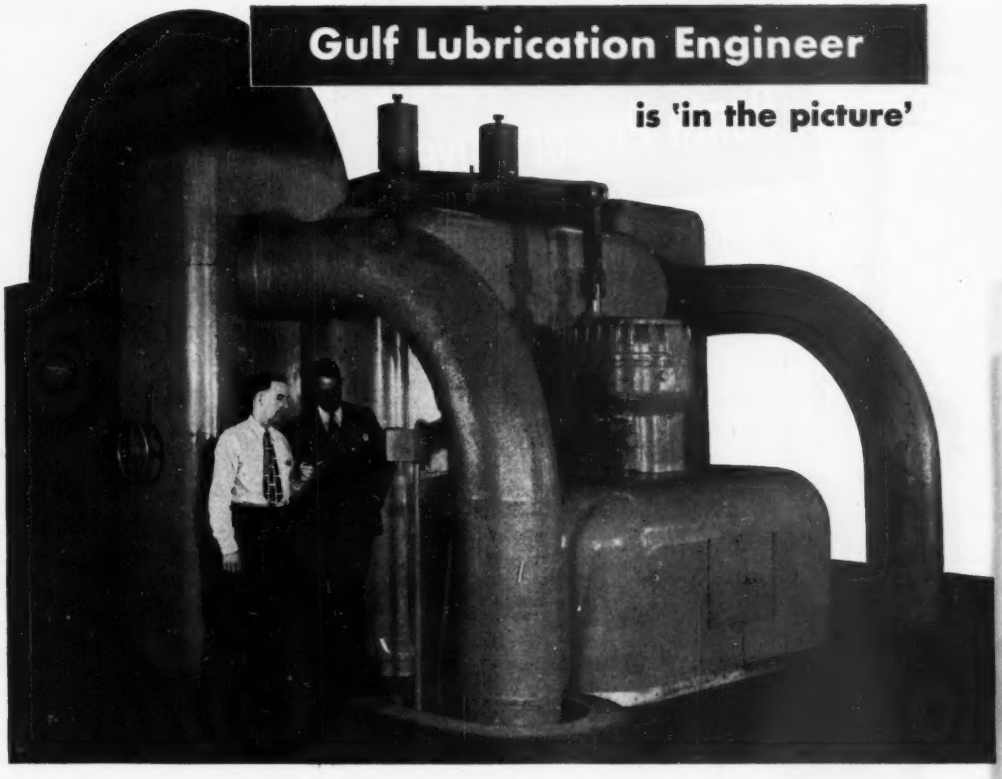
You get practical help

on lubrication and maintenance problems

when the

Gulf Lubrication Engineer

is 'in the picture'



One of the best sources of help on any problem that involves lubricants, lubrication, or maintenance of power plant equipment is a trained Gulf Lubrication Engineer.

Gulf Lubrication Engineers are experts in petroleum technology—they are familiar with refining processes, properties, and the past performance records of various types of lubricants. They completely understand the effect of different operating conditions on lubricants. And, just as important, they know the lubrication requirements of all types of turbine units and auxiliary equipment.

The application of this knowledge and experience to each individual problem helps reduce maintenance costs for power plant equipment.

To get the benefits of this expert engineering service for your plant, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office. Gulf Oil Corporation · Gulf Refining Company, Gulf Building, Pittsburgh 30, Pennsylvania.

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Invite your Board of Directors to climb a pole

...and they'll approve Penta Preservative!

It's Clean! • It's Certain!

When you climb a pole treated with PENTA Preservative you quickly see the advantages of this modern protection for poles and cross-arms.

First, you'll notice that a PENTA-protected pole is clean—not sticky or irritating to the skin. PENTA permits full-length preservative treatment with no fear of complaint from your customers or line crews.

Then, when you examine a pole and cross-arms that have been in service for a number of years, you'll see how well the PENTA treatment has done its job of protection. No signs of ground line decay, shell rot, top rot, or insect damage.

PENTAchlorophenol is a powerful, stable and uniform wood preservative —allows measured and positive protection. It penetrates deeply and will not leach out. Doesn't affect conductivity, creates no special problems.

Specify PENTA treatment for safeguarding your poles, cross-arms and other wood construction. Write us for complete facts and convincing data.

CHAPMAN CHEMICAL COMPANY
Dermon Building • Memphis 3, Tenn.

CHAPMAN

PENTA
PRESERVATIVE

Conforming to A. W. P. A. Specifications P8-49 and P9-49.

LOADS on lines to 33 kv can be checked with ammeter-on-hot-stick with little climbing through equipment on pole

siderably the obstacles through which the lineman must climb.

Load checks are made on circuits of 33 kv and below. Accuracy is within 2%. Experience shows that the instruments are adapted for use by troublemen, senior line crews, or other operating people measuring loads. Ruggedness of the instrument makes it suitable for carrying on line trucks or trouble trucks with no fear of damaging it.

Some of the types of load checks made are: Overloaded transformers, both single- and three-phase junction fuse blowing, as well as load checks on 33 or 12-kv taps.

Versatile Jeep Pulls Cable, Digs Trenches

A jeep with appropriate attachments is being used by the Consolidated Edison Co of New York, Inc, to dig trenches and backfill them, as well as for pulling cable into newly installed duct lines.

This jeep automatically digs a 10-in. wide and 5-ft deep trench at the rate of 4 to 6 fpm. It advances in a straight line as it digs through the use of a cam and ratchet and a steering wheel lock bar. This small automotive unit is used primarily on combination elec-

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Engineers-Constructors for a
distinguished group of clients, INCLUDING:

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CONTINENTAL CAN COMPANY, INC.
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HERCULES POWDER COMPANY
HILO ELECTRIC LIGHT COMPANY, LTD.
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SMOOTH BORE CONDUIT

for safe, quick pull-throughs—

with

BERMICO®

8-FT. LENGTHS

YOU WON'T HAVE TO WORRY about short-circuits caused by sheath abrasion when you do your fishing through Bermico Fibre Conduit. The unusually smooth bore of its 8-foot lengths provides a continuous raceway through which cable and wires can be speedily drawn—without injury to their coverings.

Another advantage is Bermico's **Complete Line of Bends,** which, with 5° angle couplings, enables you to meet unusual field conditions.

EASY TO WORK AND HANDLE

Bermico is **Easy to Work and Handle,** too. Its long lightweight lengths can be cut and tooled right in the field . . . make work easier . . . speed up installation.

You get **High Mechanical Strength** with Bermico. Tough and resilient, it offers best possible protection against accidental damage to wiring.

SMOOTH BORE

On your next job, plan to use Bermico Fibre Conduit. Its durability, safety and low maintenance cost will provide savings which will pay dividends over the years.

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Electric Supply Company

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A PRODUCT OF BROWN *Company*

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SOLKA & CELLATE PULPS • SOLKA-FLOC • NIBROC PAPERS
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SEWER PIPE, CONDUIT & CORES • ONCO
INSOLES • CHEMICALS

DIGGER attached to jeep digs duct trenches 10 in. wide up to 5-ft deep at 4 to 6 fpm in new developments

SNOW-PLOW ATTACHMENT is used to backfill trench and then jeep (4,000 lb) "rides" trench to pack dirt. Hydraulic winch and steel line can be attached to jeep front to pull cable in duct

tric and gas multiple installations at new housing developments. A low-low additional forward shift makes it possible for the jeep digger to get into and dig in new dirt streets. The narrow trench permits maintenance of traffic with steel plate bridging wherever street crossings are encountered.

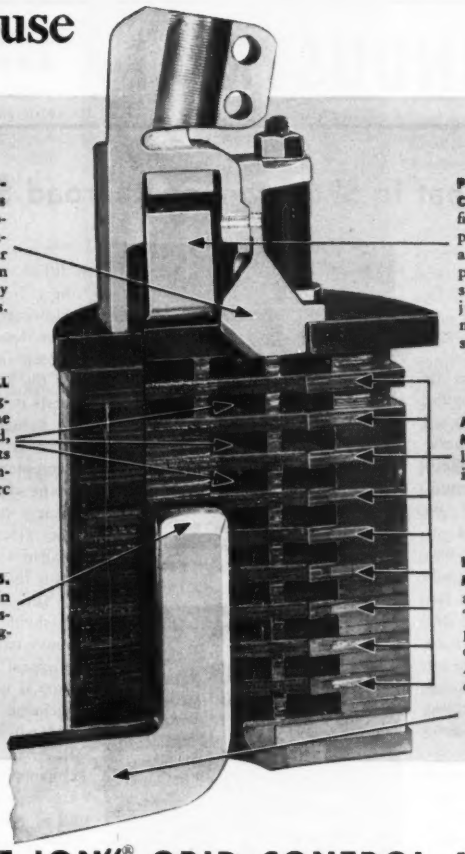
A One-Man Operation

Only one man is needed for the digging operation. The jeep has dual wheels on the rear axle and has a 15-hp power take-off for the digging mechanism. When not in use the digger is raised and rides upright on the back of the jeep. After the distribution facilities have been installed the jeep backfills the trench with a snow plow attachment on its front. When the trench is filled the jeep's 4,000 lb are used to "ride" the trench to settle the fill.

The front of the jeep can be fitted with a hydraulic winch and 60 ft of ¼-in. steel line for pulling in service, street lighting, and secondary cables.

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



ARC HORN PROTECTS CONTACTS. Arc horn supplements "De-ion" Grid action to protect contact faces from burning. As contacts open, upper arc terminal transfers from finger to arc horn. Easily removable to inspect contacts.

EFFICIENT INTERRUPTION AT ALL CURRENT VALUES. Arc is magnetically forced back into the closed section of the grid, where oil trapped in pockets provides fresh flow of unionized gas . . . prevents arc from restriking.

ARC-RESISTING CONTACT TIPS. Maximum life of contacts in high-capacity breakers is assured by arc-resisting, tungsten alloy contact tips.

POSITIVE, LOW-RESISTANCE CONTACT. Large contact fingers, backed by heavy compression springs, assure adequate contact and proper pressure over entire contact surface without sensitive adjustments. Contacts easily meet the momentary and four-second ratings.

ARC PATH LENGTHENED BY MAGNETIC CONTROL. Insulated iron plates pull the arc into contact with fresh oil.

LONG CONTACT LIFE CUTS MAINTENANCE. Contact areas are kept free from burning by "De-ion" Grid action. Grids provide rapid control of fault currents by quenching the arc. Arc is drawn into the pockets of grid, cooled and snuffed out.

EXCLUSIVE "DE-ION"® GRID CONTROL ASSURES

Greater Service Continuity

FOR 15 TO 69-KV LINES

DESIGN TESTED AND VERIFIED IN THE Westinghouse HIGH POWER LABORATORY

Only Westinghouse Outdoor Frame-mounted Oil Circuit Breakers give you "De-ion" Grid Arc Control, which sharply reduces contact burning and oil deterioration. The result . . . *substantially reduced maintenance costs!*

Get the facts about this and other *plus* features of Westinghouse Breakers. Call your nearby Westinghouse representative, or write for booklet B-3686-A. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-60737

Westinghouse

POWER CIRCUIT BREAKERS

Electric Heat In Shops Saves Railroad $10,000

A. C. GIBSON

H. S. EVANS, JR.
Power Sales Engineers
Nashville Electric Service
Nashville, Tenn.

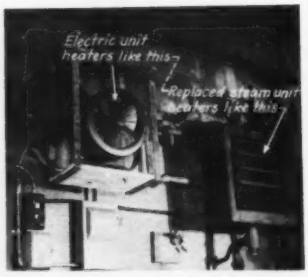
Installation of electric heat in its Nashville shops saved the Nashville, Chattanooga & St. Louis Railroad $10,000 in the first season of operation. This was possible through elimination of all direct labor costs, minimizing distribution losses, and by using localized heat where needed.

Decision to make the conversion was made when tubes of a 500-hp coal-fired steam boiler burned out. It became necessary to repair the boiler or revise the heating system, even to the extent of changing the type of heat. A detailed survey by industrial engineers of the Nashville Electric Service indicated that it would be economically desirable to heat these buildings with electricity.

The original steam heating system made use of two coal-fired boilers, one 500 hp and one 300 hp. In addition there were three 100-hp hand-fired boilers in operation which had previously been installed to burn planing mill chips. An additional boiler casualty forced the removal of the 300-hp boiler. By using electric heat for the outlying buildings three fuel-fired boilers can carry the main warehouse load. The three old hand-fired boilers have been removed and the small volume of planing mill chips are now hauled away.

The Nashville, Chattanooga & St. Louis Railroad, like most railroads, started changing from steam to diesel operation a year ago and since then approximately 90% of all machine shop work has ceased—and while the occupancy dropped proportionately the steam heat usage declined but slightly.

As a result of the conversion, twelve buildings are now heated electrically. Electricity is also used to heat the sanitary hot water supply, for drying sand, and for heating the oil and oily waste. Since the electric heat is not separately metered, and due to the "change over to diesel" program, it is difficult to separate the cost of electric heat from that of the normal load. However, based on the present summer load an over-all cost can be closely approximated. A breakdown of the load and the original estimated costs is shown in the table.



ELECTRIC SPACE HEATERS replaced steam unit heaters (right)—saving labor and putting heat where it was wanted

STRIP HEATERS replaced steam coils in heating drums of cylinder oil. Heaters are battered but have not failed

Load Breakdown and Estimated Operating Cost

Use	Kw Installed	Est. Kwhr Per Yr.	Est. Cost Per Yr.
Space heat	238	332,000	$2,400
Water heat	28	170,000	850
Sand Drying	25	200,000	900
Oil house	18	117,000	510
Waste house	5	32,000	140
	314 kw	851,000	$4,800

Actual operating cost for the past year is approximately $4,200. The increment energy rate is 3 mills per kwhr with a 30 min integrated demand charge of $1 per kw. Initial cost of the electric heating equipment installed was almost $9,500 as compared with the original estimate of $9,000.

This installation was the second of Nashville's three railroad shops to be converted to electric heat. A complete proposal for conversion of the third shop is now before the railroad management.

Nashville, Chattanooga & St. Louis Railroad is so well satisfied with this conversion to electric heat, that they are presently engaged in electrifying all outlying stations requiring labor to provide space heat.

Immersion Heaters Up Battery Production

Immersion heaters, cast in four 2,000-lb capacity lead melting pots at Reading Batteries, Inc, Reading, Pa., increased production 25% over the previously-employed heating method using coal stokers. Cost of power consumed by the heaters is less than the maintenance cost alone of the stokers. Working conditions have greatly improved because of the low radiant heat loss of the electric units.

Each of the four pots has three 5,000-w, 230-v, immersion heaters. Automatic temperature control equipment keeps contents of pots at constant temperature of 800 F. After heaters were installed four years, they completed 125,000 hr of continuous operation without maintenance or

down time. Pots are used to melt pigs of antimonial lead for molding grids and other lead battery parts. At each melting pot the molten metal is poured into mold cavities. After the lead parts have been chilled in the molds they are passed on to a trimming machine for finishing. During an 8-hr period, an average 10,000 lb of metal for casting grids is removed from the melting pots.

▶

LEAD-MELTING POT, heated by three 5,000-w cast-in immersion heaters, is one of four which increases storage battery production 25% at plant of Reading Batteries, Inc. Automatic temperature control maintains 800 F. Operating cost is less than maintenance cost alone of previously-used coal stokers

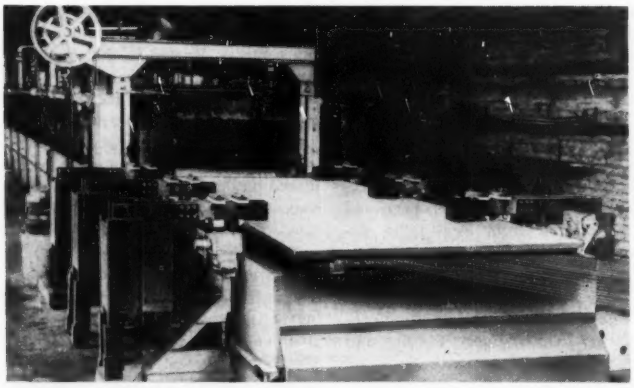
General Electric Co photo

Electric Salt Bath Triples Output

An electric salt bath furnace has replaced an old salt bath heated by immersion type gas heaters used for wire patenting at the Macwhyte Co, Kenosha, Wisconsin. Production has increased from 800 lb of wire an hour to from 2,000 to 2,500 lb an hr. Pickling time has been decreased by 30%. Temperature of the furnace can now be maintained at 980 to 1,000 F (depending on the analysis of the wire), and controlled to plus or minus 5 F. The former gas heaters were unable to maintain either the required temperature or close temperature control.

The furnace electrodes are expected to last indefinitely, whereas the gas heaters lasted only a short time and replacement cost was high. The curtailment of production resulting when the gas immersion heaters needed replacing was also quite costly. In addition, the gas heaters caused a great deal of sludge due to local overheating which meant frequent desludging of the furnace—an expensive and laborious operation, under the best of conditions.

Installation is rated at 120 kw, 440 v, single phase.



Ajax Electric Co photo

WIRE PATENTING in electric salt bath furnace increases production from 800 lb of wire an hour (with old gas heated furnace) to from 2,000 to 2,500 lb per hr with same size furnace. It has high degree of temperature uniformity throughout bath, excellent temperature control, ease of operation and low power consumption, according to W. R. Bloxdorf, chief metallurgist at Macwhyte Co

INDUSTRIAL BRIEFS

Power Distribution problem at United Airline's maintenance base at San Francisco Airport was solved by an extensive bus duct installation. This system transmits power very efficiently, without undue voltage drop; it enables machines to be easily added or moved about the plant and provides essential power flexibility for new developments and changing maintenance methods. Main building has a transformer rated at 500 kva, 120/208 v, 3-phase, 4-wire in each of four sections of the structure. Each section has a separate bus duct system. Hangars have two separate bus duct systems.

Electric Water Heating at the Liberty Fuel Co coal mine near Helper, Utah, saves $5 a day in spite of a free coal pile; provides constant supply of controlled temperature hot water with no maintenance or trouble. Installation has an insulated 30-gal heater tank with four 5-kw and one 3-kw immersion heaters, a 1,000-gal insulated storage tank and a small circulating pump. Monthly consumption is approx 4,700 kwhr.—W. L. Fadis, Div Sales Mgr, Utah Power & Light Co.

Drying Vinyl Plastic sheets with infrared electric radiant heaters, an eastern safety glass manufacturer has increased the drying rate 33⅓% over previously-used method having same Btu output. Heaters provide absolute uniform heating across vinyl sheet and high absorption of moisture, with no breaking hazard. Each of the six heaters used is 2,275 w, 230 v and 48 in. long, spaced 10 in. apart and is mounted 6 in. above the vinyl sheeting which is carried on conveyor having 22 fpm speed. Radiation exposure time is 15 sec.

SEND IN YOUR INDUSTRIAL BRIEF

You'll get more satisfaction from knowing your item helped someone else than from the $5 you will be paid for each item accepted. Give us the basic facts covering the application; the name and location of user, benefits, advantages, and load characteristics of the application.

Home Freezing Center Increases Sales 120%

W. H. BARNWELL
Dealer Coordinator
South Carolina Electric and Gas Co
Charleston, S. C.

After five months operation of a Home Freezing Demonstration Center in Charleston, S. C., freezer sales increased 120%. More than 1,000 housewives were instructed in the preparation of freezing all types of foods. Public reaction was tremendous and caused the utility to continue this project as a permanent part of its customers service program.

Sponsored and carried out by the South Carolina Electric and Gas Co, Charleston, S. C. and the appliance distributors, the success of this freezer center has proved that education by personal contact and instruction is necessary to do the job on products that do not yet enjoy full public acceptance.

FREEZING DEMONSTRATION CENTER has instructed more than 1,000 housewives in 5 months and increased freezer sales 120%. Public reaction caused utility to continue project as permanent customer service depending on conditions

Freezer Promotion

In the early spring of 1950, the utility decided to inaugurate a vigorous promotion of home freezers. This utility does not merchandise, but maintains an active and efficient dealer coordinating department.

The first step was to determine what type of promotion would be most effective from both the utility and the dealer standpoint. To accomplish this, appliance dealers were contacted to discuss this problem, and as a result the following was decided: First, it was agreed that this promotion should be of an educational nature; second, that it should be of long range and not merely a campaign of short duration; and third, that the entire program would be sponsored and carried out by the utility and the electrical distributors.

It was then decided that instead of a promotion of an advertising nature, one of individual instruction for the housewife would eventually be the most fruitful. A financial pool of contributions from the distributors and the utility was set up in the name of The Home Freezing Demonstration Center, and a small store was then leased in the downtown shopping area. This store was equipped with waist-high processing tables, and wired for the operation of 12 home freezers of a 10 to 15-ft capacity. Each participating distributor placed his freezer in this building, now known as the Home Freezing Demonstration Center. This center is open daily from 10:00 am to 5:00 pm, and is staffed by the Home Service Department of the South Carolina Electric and Gas Company. Invitations and announcements are made in local papers, and are broadcast from local radio stations.

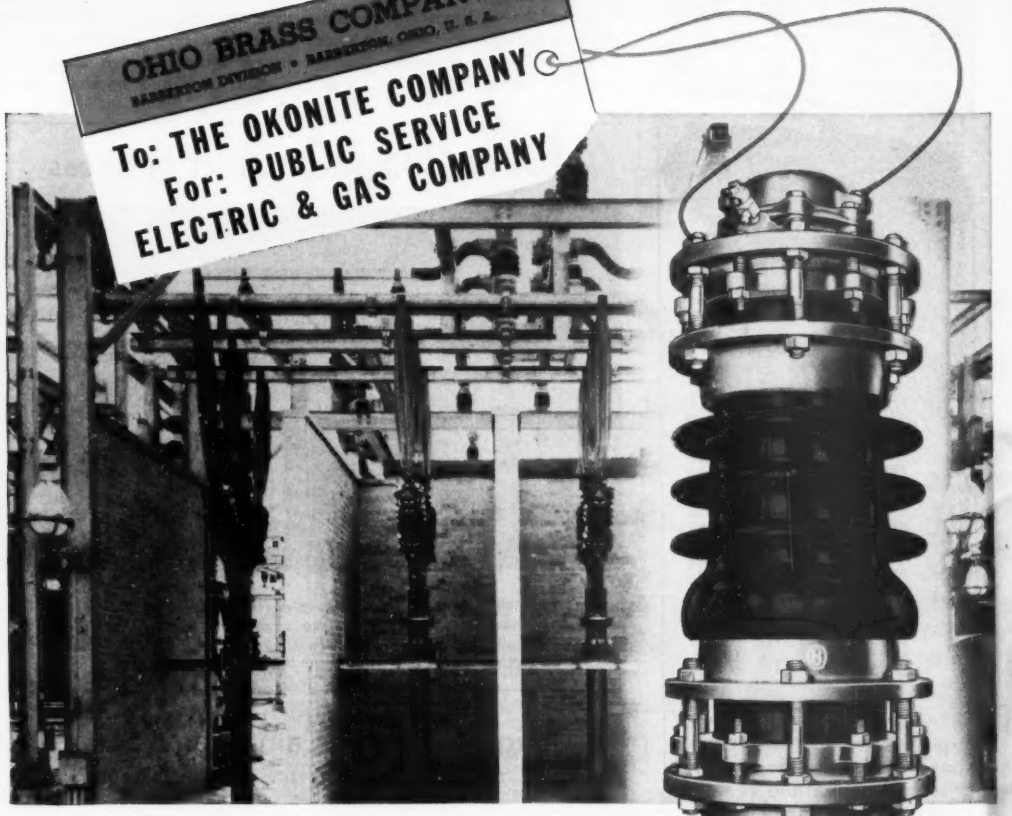
How Freezing Center Works

The operation of this freezing center is as follows: Every Tuesday and Thursday special demonstrations are advertised and on these days 50 lb of food are processed, packaged and frozen. For these special activities, four home economists in white uniforms perform at the packaging tables, and small groups of observers watch, ask questions, or participate in the program. On the days when demonstrations are not in progress, one home economist is in charge of the center to answer any questions and to explain various methods of packaging and freezing. Free parking is furnished at an adjacent parking lot and all publicity points out that this freezing center is located in the shopping district for the convenience of the housewife. Due to the fact that this is a long range promotion, no attempts have been made to encourage large crowds, and strong emphasis has been placed on the fact that interested persons shall receive individual attention.

To determine the number of freezer owners and non-owners attending the demonstrations, a large sign containing a given number of red and green cards was placed near the exit. This sign requested the housewife to take a red card if she owned a freezer and by turning this card in would receive a book on home freezing. The non-owner was asked to take a green card and by turning it over to a dealer when purchasing a freezer, she would

OHIO BRASS COMPANY
BARBERTON DIVISION • BARBERTON, OHIO, U. S. A.

To: THE OKONITE COMPANY
For: PUBLIC SERVICE
ELECTRIC & GAS COMPANY



The Switch Yard at the Sewaren Generating Station of Public Service Electric and Gas Company is 500 feet from the generator terminals. Along this path exist the congested areas around the turbine and boilers which precludes the use of any space-consuming bus structure for the main generator leads. Forced cooled Oilostatic cable systems installed in tunnels were used to solve this problem. This resulted in a very economical installation where only 6,000,000 cir mils of copper per phase were needed to carry the output of a unit. Since three such generators are involved, a considerable economy is effected. An essential element in the 72 terminals of this cable system are - - -

O-B Potheads
An Integral Part of
Oilostatic Cable

Ohio Brass
MANSFIELD OHIO, U.S.A.
CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONT.

4117-M

EVERSTICK ANCHORS...

FIRST CHOICE
for

- PERMANENCE
- HOLDING POWER
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They speed up work and provide dependable anchorage in new construction and maintenance. Quick and easy to install—made of tough rust-resistant malleable iron—their holding power "tops" all others. Available two-way, three-way, four-way and cone types. Write for facts.

Exclusive Everstick nut housing. Locks anchor firmly on rod. No chance of rod slipping thru anchor.

EVERSTICK ANCHOR CO.
Manufacturer of
"THE ANCHOR OF MERIT"
FAIRFIELD, IOWA

receive 40 lb of frozen food at no additional charge.

During the third month of the promotion a week long campaign on home freezers was put on by the dealers and distributors. This campaign included full page ads in newspapers, radio programs, and a parade of more than 30 trucks, each carrying a home freezer and appropriate banners. This parade toured through all the residential areas and housing projects.

Uses Lighting to Attract Business

General Electric Co photo

ONE OF THE FIRST in the Midwest to use mercury-vapor street lights for building illumination, this retail business block on a corner in Chicago stands out in the night. The luminaires which provide about 10 ft-c on the store-fronts and sidewalk were installed to attract nightshoppers to the seven-store building

1950 Lighting Sales Campaign Beats 1949

Bigger jobs were the outstanding characteristic of the 1950 Fall Lighting Campaign of the Electric Association of Philadelphia in comparison with the 1949 activity. In 1950 there were 23% more jobs sold. That was something to crow about, but it is small relative to other increases. Number of fixtures sold was 67% higher, their retail value 81% more, and the connected load was up 73%.

The campaign, devoted to industrial, commercial and exterior lighting, started September 11 and continued to mid-December. Participating in it were 27 manufacturers of lighting equipment, 3 lamp makers, 15 electrical wholesalers, Philadelphia Electric Company, and, through the active official participation of the Penn-Del-Jersey Chapter, NECA, the Independent Electrical Contractors Assn of Phila., the Delaware County Electrical Contractors Assn, the Bucks-Montgomery Section of the Electrical Association, and the contractors Division of the Electrical Association, all electrical contractors in the five-county area, were made eligible to take an active part in the promotion.

Again in 1950 salesmen of jobbers and of the Philadelphia Electric Co had the incentive of competing for cash prize awards totaling $2,300. In addition to these prizes for salesmen,

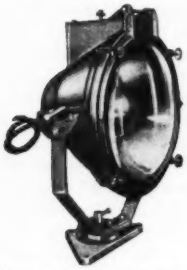
Results of 1949 and 1950 Co-Operative Fall Lighting Campaigns of the Electric Association of Philadelphia

	1949	1950	Increase, percent
Jobs Sold	1,583	1,944	23
Fixtures Sold	42,816	72,060	67
Retail Value of Fixtures	$1,158,800	$2,095,740	81
Connected Load Sold (kw)	8,152	14,083	73

Light! ... for PROTECTION

Type DCX-18 Searchlight

Type ADE-14 Floodlight



Type LCE-1120 Floodlight

America is faced with the ever-present danger of sabotage that would cripple vital services and production facilities. Sabotage thrives in darkness. The most reliable and cheapest form of protection against night prowlers is LIGHT!

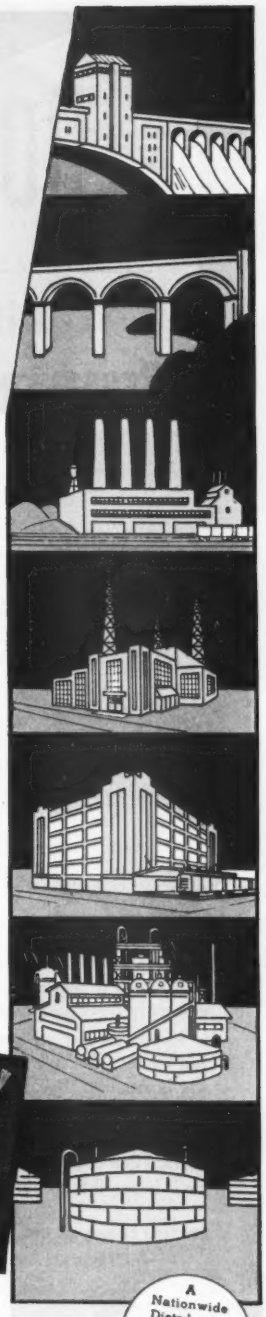
CROUSE-HINDS Floodlights

project powerful beams of light that bathe all approaches to your property with glaring radiance, killing darkness and shadows and compelling everyone to be more visible at night than in broad daylight.

The protective power of light should be used in all important municipal and industrial locations, including waterworks, dams, pumping stations, gas works and gas storage tanks, electric power plants and substations, factories, mills, mines, bridges, docks, warehouses, railway terminals, tunnels, shops and freight houses, canal locks, and aqueducts, oil refineries, pump houses and storage tanks, telephone and telegraph stations, radio stations.

The floodlighting of industrial plants serves a double purpose. It helps to boost production in addition to the security it provides.

Crouse-Hinds offers a complete line of floodlights and searchlights that will meet the needs of any type of protective lighting. Crouse-Hinds illumination engineers have a wealth of protective lighting knowledge that is at your service. Send for your copy of Bulletin 2565, "LIGHT! Protect Your Property."

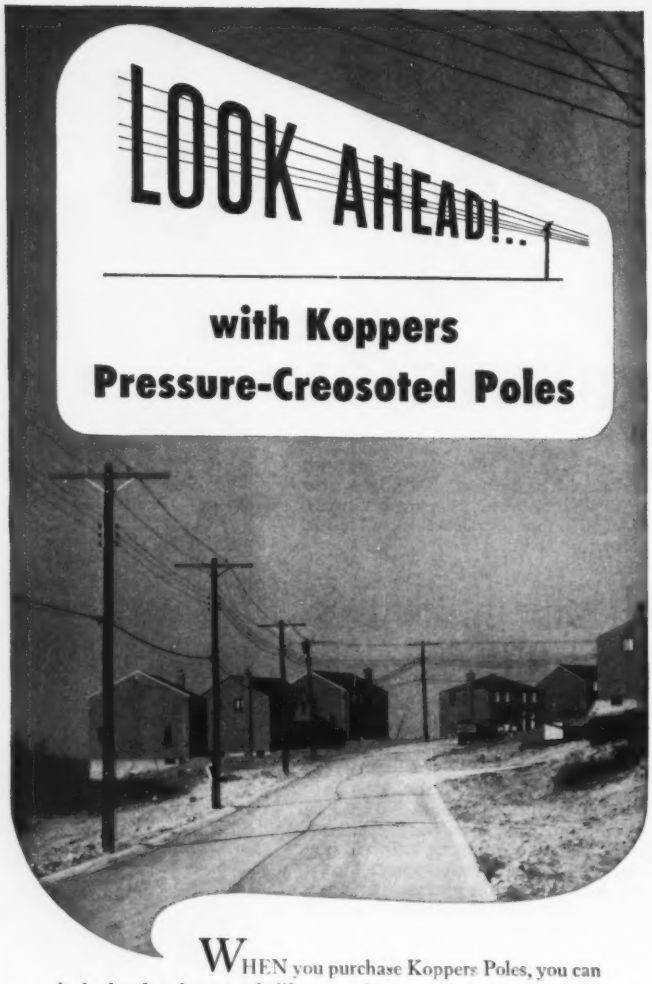


CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee Minneapolis — New York — Philadelphia — Pittsburgh — Portland, Ore. — Salt Lake City San Francisco — Seattle — St. Louis — Washington. *Resident Representatives:* Albany Atlanta — Baltimore — Charlotte — New Orleans — Richmond, Va.
CROUSE-HINDS COMPANY OF CANADA, LTD., TORONTO, ONT.

A Nationwide Distribution Through Electrical Wholesalers

FLOODLIGHTS • AIRPORT LIGHTING • TRAFFIC SIGNALS • CONDULETS



WHEN you purchase Koppers Poles, you can look ahead to *longer* pole life . . . to *longer* periods of continuous company service . . . to *lower* annual operating costs.

Koppers Poles are pressure-creosoted against decay for their full length. Because of highest standards of treatment, longest life is assured. Because they *retain* their strength, fewer poles go out of service, even under the most severe climatic conditions.

Be sure to specify Koppers Full-Length Pressure-Creosoted Poles. Then *you* will be all set to look ahead to the best pole service it is possible to purchase.

KOPPERS COMPANY, INC., Pittsburgh 19, Pa.

KOPPERS PRESSURE-CREOSOTED WOOD

a fund of $700, subscribed by the five contractor organizations, will be divided into 16 cash awards for the winning electrical contractors.

Featured CLM's Boost Lamp Sales

C. A. STEVENS
Public Service Electric & Gas Co
Newark, N. J.

In the 3½ months, Oct. 1-Jan. 15, 8,278 portable lamps of all types were sold by Public Service Electric & Gas Co. This was a CLM campaign with 7 lamps featured as leaders and of these 4,643 were sold. Of the total sold, CLM's are an estimated 60%.

This lamp campaign is an annual activity, but the one this fall and winter differed from those of former years. It lacked the incentive prize contest for salesmen which was included in previous campaigns. Installment sale terms were not as liberal as before. Offsetting these apparent

CLM THEME was carried on 12 painted and illuminated billboards

drawbacks was something not done previously. Heavy emphasis was put on prices in all advertising and display. Result was that total sale was actually 31 units more than 1949.

Price range of the leader models was $9.95 to $20.95 with reductions for employees. They included one floor, one bridge, one chair, and four table models. Each company district set its own quotas of the 7 leaders. They varied from 530 for the largest to 30 for the smallest. The quotas totalled 4,000 units. The final figure of sales was thus 16.1% over quota. Evidently the floor lamps were easier to sell or the salesmen put more effort on them because of larger commissions. The quota of these lamps was 2,529 and 3,054 were sold, about 21% over. The table lamp quota was 1,471 and 1,589 were sold, 8% over.

CHECK THE FEATURES OF ELECTRONIK POTENTIOMETERS THAT MEAN MOST TO YOU . . .

- SIMPLICITY
- ACCURACY
- DEPENDABILITY
- RUGGEDNESS
- FLEXIBILITY

UTILIZE THE SIMPLICITY OF ElectroniK RECORDERS

CHECK THESE SIMPLICITY FEATURES

- √ *Sturdy, electronic amplifier replaces delicate galvanometer.*
- √ *Continuous measurement replaces cyclic re-balancing.*
- √ *Charts are readily accessible without moving chassis.*
- √ *No need for shielding or special circuit precautions.*
- √ *Movement takes place only when measured variable changes.*
- √ *Instrument includes only five basic components.*
- √ *Bridge and slidewire are unaffected by electronic circuit.*

INDICATING and recording instruments for any steam generating plant should reflect the simplicity so essential to dependable operation. And, the simplified design of *ElectroniK* Potentiometers . . . Precision Indicator, Circular and Strip Chart Recorder . . . accounts for the new records they are setting for continuous and satisfactory service.

A check of the outstanding features that contribute to the simplicity of *ElectroniK* Potentiometers . . . plus a practical appraisal of their construction *ruggedness*, performance *dependability*, operation *accuracy*, and application *flexibility* . . . will give you a clear picture of how they are able to increase plant efficiency.

Call in your local Honeywell engineer for a discussion of their utilization in your plant . . . or write for a copy of Bulletin 90-1.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4568 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

MINNEAPOLIS Honeywell

BROWN INSTRUMENTS

NEW EQUIPMENT

Telescopic Derrick

Multiple pulley blocks can be used with the Uni-Lift, a telescopic single-leg derrick which can be installed on ½, ¾, and 1-ton trucks. Its maximum capacity of 1,500 lb and maximum height of 14 ft 10 in. permits setting poles up to 35 ft in length.

For convenience in handling materials of different size, weight, and shape, the derrick base is keyed so the boom can be positioned at two angles of elevation. Upper section of the boom may be telescoped for greater capacity when maximum height is not needed.

Derrick is raised semi-automatically by means of a heavy-duty elevating spring. When not in use the boom is stowed in a telescoped position along the body side panel where it will not interfere with items carried in the loading area.

When the truck is operated over smooth terrain, this derrick may be used to carry poles for short distances. A lashing ring is provided on derrick base.

McCabe-Powers Auto Body Co, 5900 N. Broadway, St. Louis 15, Mo.

•

CO_2 Weighing Device

Carbon dioxide cylinders can be weighed during periodic tests without taking the system out of service by use of a new device. Weighing 28 lb, it is constructed of channel iron and its scale has a capacity for weighing up to 200 lb.

To use the tripod device, the operator loosens the clamp bolts holding the CO_2 cylinder, inserts the fulcrum under the neck of the valve, presses hand lever until cylinder clears the floor, and reads the scale for the weight. This Alfco System Weighing device has height of 55¾ in.

American-LaFrance-Foamite Corp, Elmira, N. Y.

•

Oscilloscope

Mounting the 5-in. cathode ray tube of Model 476 Mirroscope in a vertical position has resulted in lessened space requirements. Bench space needed is only 9x8 in.

The cathode ray image is reflected from a mirror mounted in the adjustable cover at the top of the cabinet.

This brings the viewing surface near eye level when the instrument is used on benches of normal height. Mirror and wing sides at top—for deflecting light—fold into cabinet when it is not in use. Height is 16¼ in., width 9⅛ in.

Simpson Electric Co, 5200 W. Kinzie, Chicago, Ill.

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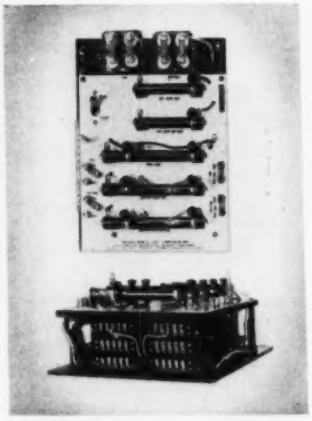
Loss Compensators

Transformer - loss compensators, Cat. No. 1013 and 1014, provide a means of measuring the energy and demands of high-voltage services from



the low-voltage side. The compensator adds to the registration of the watt-hour meter an amount that is equal to the sum of the iron and copper losses of the transformer bank. The method is intended primarily for use on customers' installations where the contract provides for supplying and billing at distribution or transmission voltages.

Two and three-element models are produced for use with two-element or three-element meters on any type circuit. They may be connected into the 5-amp secondary circuit of the meter current transformers and will carry 100% overload continuously. They are rated 120/240 v for direct connection to the low-voltage supply, or to the secondaries of the meter potential transformers. Front and bottom views of a two-element compensator are pictured.

Bulletin 63-A describes the compensators and their advantages for use with primary voltages down to 13.2 kv.

The Eastern Specialty Co, 3617 N. 8th St, Philadelphia 40, Pa.

•

Electric Vibrators

All metallic striking parts are said to be eliminated in the Semi-Noiseless line of electric vibrators. Instead of a metal plate striking the springs, the springs pound against rubber

FOR BETTER INSULATION ... EASY REPLACEMENT

The Hubbard No. 8128-W Brace makes it possible to replace a standard 28-inch Steel Brace with a Wood Brace, without drilling new holes or otherwise altering the structure. It is designed as a means of increasing the impulse insulation level of medium voltage lines. These Braces may be used singly or in pairs. High strength in compression, as well as tension, is an outstanding feature of this Brace. The Wood Section is 1-inch by 1½-inches, creosote dipped hickory. The channel steel sections are reversed at the ends to permit installation with the flat side of the channels against the crossarm and the pole. Stock No. 8128-W covers a pair of Braces. Braces are interchangeable—there are no lefts nor rights—therefore, even though Braces are ordered and shipped in pairs, they may be used singly. Metal fittings double-dip, hot galvanized.

HUBBARD AND COMPANY

ESTABLISHED 1843

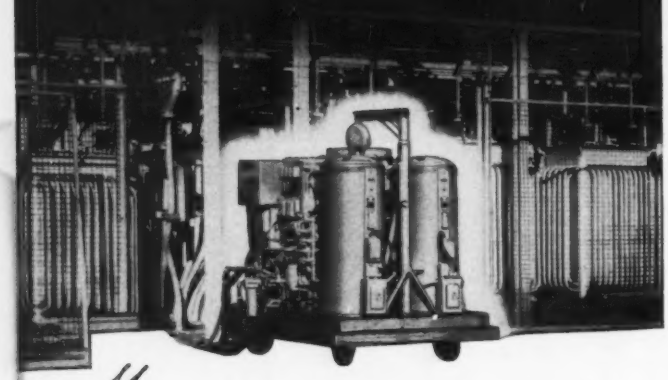
PITTSBURGH • CHICAGO OAKLAND, CALIFORNIA

"Hang the Load on Hubbard Hardware!"

Eliminate SHUT-DOWNS and EXPENSIVE REPAIRS

on Transformers, Turbines and Diesel Engines

with HONAN-CRANE Oil Purification Equipment



Many leading utilities such as Detroit Edison, Ohio Public Service Co., Pennsylvania Power, etc., have standardized on Honan-Crane oil purification equipment for removal of damaging contamination from insulating, Turbine and Diesel oils.

Honan-Crane can give you exact equipment to do the job. Equipment that will remove all types of oil contamination.

In every installation Honan-Crane equipment quickly pays for itself out of savings in oil and maintenance costs.

● **Write today for Honan-Crane Bulletins: "Purification of Insulating Oils", "Purification of Turbine Oils".**

FOR TRANSFORMER INSULATING OILS

Houdaille Purivac (Shown Above)

A complete automatic system for purifying, dehydrating and degasifying insulating oil in the field or at a central location. For large volume purification requirements.

Honan-Crane "R" Type Purifier

Mobile oil reconditioning unit for centralized batch purification. Ideal for volumes of oil requiring capacities up to 200 GPH.

FOR TURBINE AND DIESEL OILS

Honan-Crane "M" Type Purifier (Right)

"Continuous" type purifier removes solid contamination as well as products of oxidation (acids, asphaltenes, gums and resins). Keeps neut. number and steam emulsion number within desired limits. Sizes to fit all needs.

HONAN-CRANE CORPORATION
819 WABASH AVE., LEBANON, INDIANA
a subsidiary of
HOUDAILLE-HERSHEY CORPORATION

bumpers. This "cushion action" results in reduced operating noise.

Among applications for these vibrators: Coal hoppers and chutes to stokers, foundry sand hoppers over mold benches, railroad hopper cars, soap chip packaging machine hoppers —wherever the flow of material is interrupted because of arching over and plugging.

Each vibrator is furnished with a controller, arranged for separate wall mounting, that contains an operating switch, a power control dial switch, fuses, and rectifier. The electronic valve in the controller changes alternating current to pulsating waves with a time interval between each wave.

The vibrators are available in four models with capacity for small hoppers of 20 cu ft to bunkers holding hundreds of tons. Input watts vary from 125 to 850 w for the different models.

Syntron Co, Box 220, Homer City, Pa.

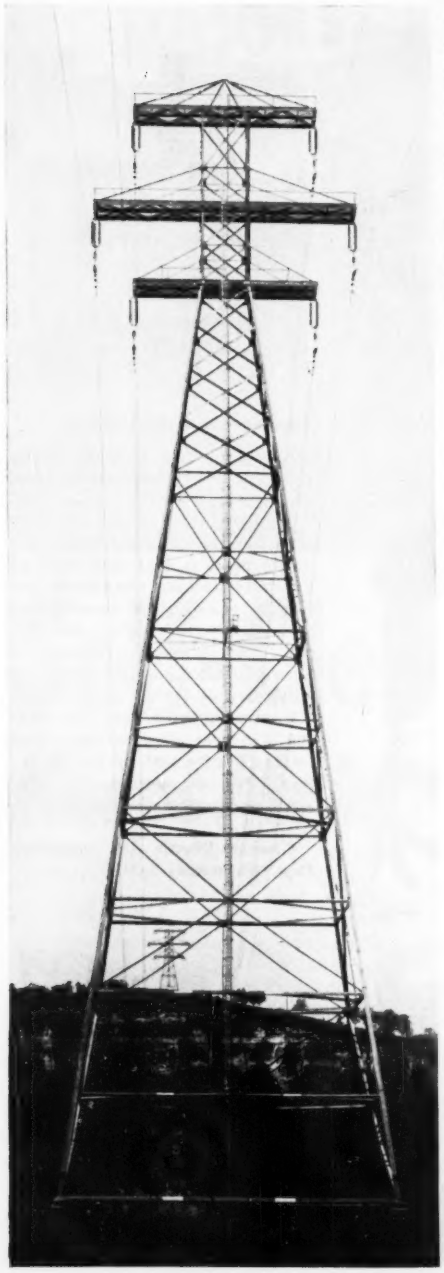
Mobile Radio Equipment

A 450-mc mobile transmitter-receiver is claimed by the manufacturer to have shown performance superior to that obtained on 160 mc in heavily built-up urban areas. Performance in suburban areas is equal to that of 160-mc equipment.

This equipment utilizes the same mountings, cables and controls as the 160-mc model. Basic transmitter-receiver Type 2210 of 160 mc is supplemented in the new unit by converter unit type 2581. The quieting sensitivity is in the order of one micro-

It's Bethlehem for Tower Work

. . . both Design and Fabrication



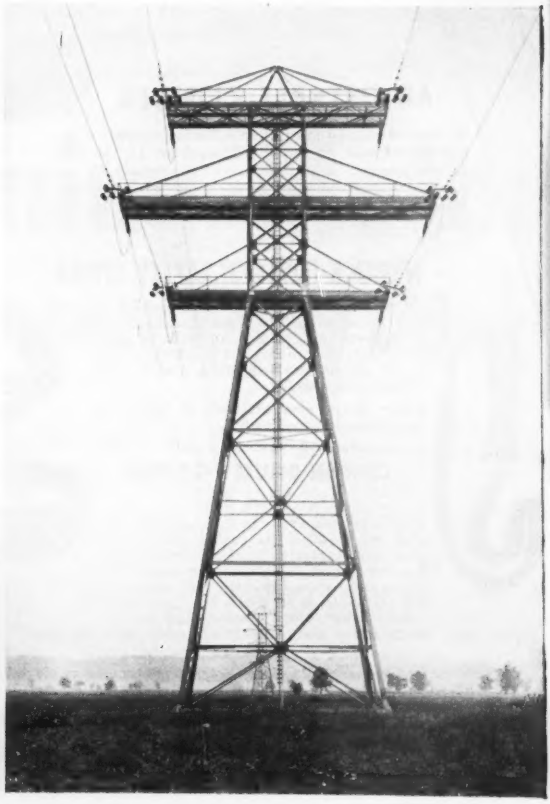
If you're looking for long-range economy and peak performance, let Bethlehem handle the design and fabrication of your transmission towers. Bethlehem's engineering staff has had years of experience in designing towers for a wide range of applications. Besides, our shops on both the east and west coasts are fully equipped for every phase of fabrication, including galvanizing. We'll be pleased to discuss transmission towers with you, any time you say.

These two towers, designed and fabricated by Bethlehem for Union Electric Light and Power Co., St. Louis (now Union Electric Company of Missouri), have for many years been carrying power across the Mississippi River at Crystal City, Mo. The 282-ft tower at left has a base width of 80 ft, and a crossing span of 4500 ft. The companion tower, a dead-end structure 140 ft high, has a base width of 42 ft, and a span of 3000 ft. Conductors for the two towers are 318,000 cm A.C.S.R.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
FABRICATED STEEL CONSTRUCTION

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL



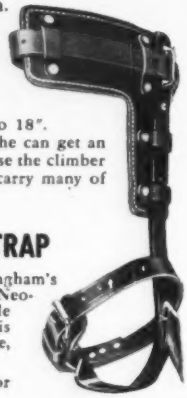
That's BUCKINGHAM on TOP

Buckingham has been up on top for more than 50 years—making safe, dependable, comfortable climbing equipment second to none. That's why you can buy with confidence if it's Buckingham.

New

ADJUSTABLE CLIMBER

We have developed an adjustable climber which *will fit any man.* Its length adjusts from 15" to 18". Advantages for the lineman: comfort, because he can get an *exact* fit; for the company: money is saved because the climber inventory is reduced. No longer any need to carry many of each size in stock.



NYBUCK (NYLON) SAFETY STRAP

Here's added safety, from Nybuck—Buckingham's new nylon strap. It's impregnated with Neoprene—strength is not affected by pole dressings, cleaning agents or climate. This is the strongest safety strap, size-for-size, being made today!

Safety straps also available in fabric or heavy-duty harness leather.

"CUSHION DELUXE" FLOATING TOOL BELT

This is far and away the lineman's favorite. And no wonder! Its cushion-edge effect gives much greater working comfort. Its floating feature (straps do not bind—they *slide* easily) means that the tool loops stay full and open at all times. It's lightweight —only 3 lbs. 12 ozs. Linemen find they can work faster and more comfortably with *this* belt.

Write for Catalog No. 24 giving complete information on the full Buckingham line. It's FREE! Or see your nearest distributor.

BUCKINGHAM MANUFACTURING CO., INC.
1-3 TRAVIS AVE. BINGHAMTON, N. Y.

volt. Fifteen watts output power is provided at 450 mc with a frequency stability of better than 0.001%, and with peak modulation control. A 100-w amplifier is also available.

Link Radio Corp, 125 W. 17th St, New York 11, N. Y.

•

Heating Control Panel

Voltage feedback from the furnace is eliminated by a redesigned control panel, company engineers report. They report that current feedback alone can be successfully used.

The panel is used with the G-E Reactrol system that varies power supplied to heating units smoothly and automatically. The system is a proportional-type temperature control for electric furnaces and other electrically heated devices.

Twenty-one inches high, 18 in. wide and 14 in. deep, one panel can be used for any heating load up to 450 kw, single-phase or polyphase. Another panel is available for loads up to 1,000 kw.

General Electric Co, Apparatus Dept, Schenectady 5, N. Y.

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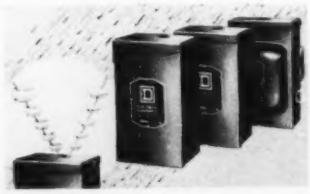
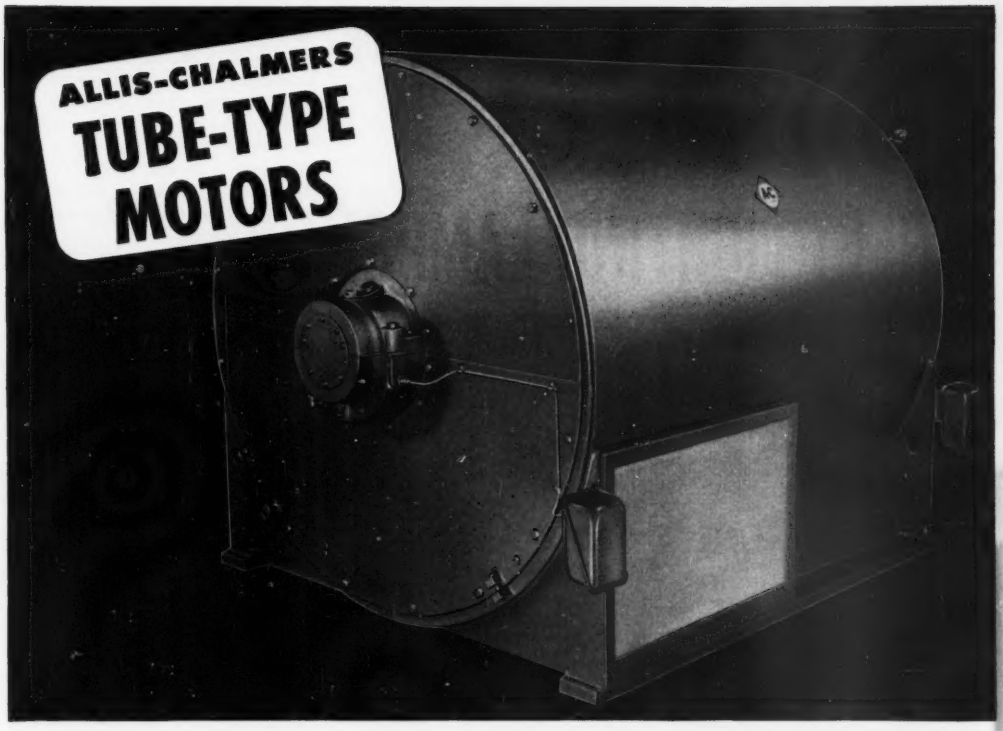


Interchangeable Hubs

Interchangeable hubs for raintight circuit breakers, multi-breakers, switches, and fusible entrance equipment are available for simplifying



Self-Cleaning Motor

Keeps Maintenance Costs Down

MOTOR CLEANING ROUTINE AND COST ARE PRACTICALLY ELIMINATED by the Allis-Chalmers tube-type, totally-enclosed, fan-cooled motor. Even when installed outdoors in contaminated atmosphere, dirt and corrosion cannot harm it.

The reason for this outstanding performance is the unique tube-type cooling system. Cooling air circulates through a nest of tubes which surrounds the stator, removing heat from the interior of the motor. The generous flow of air through the straight tubes carries dirt out to the atmosphere. There are no corners or pockets, as in conventional designs, which might collect large dirt deposits. If the tubes ever should need cleaning, a brush on a long handle will do the job in a few minutes.

Sizes range from 75 hp up. Tubes and end plates may be made of special corrosion resistant materials where necessary.

To-day, when manpower is high-priced and getting scarce, cutting maintenance time and cost is more important than ever. Ask your Allis-Chalmers representative to show you how this exceptional motor can reduce your maintenance requirements. Or write to Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 05B7150. A-3322

ALLIS-CHALMERS

On this modern New York City parkway it's

AMPLEX STREET LIGHTING LAMPS!

MANY OF THE LARGEST American municipalities and public utilities have standardized on Amplex Street Lighting Lamps both for superior lighting and for the extraordinary savings that they bring to every installation. These lamps are specially designed and built to survive the vibration and shock of road traffic and to maintain a maximum percentage of light output throughout their long-burning life.

Amplex offers you the most complete line of street lighting lamps ever put on the market . . . a type and wattage for every kind of service. Among these, Amplex Weatherproof Bulbs are probably today's fastest-growing specification. Amplex Weatherproof Lamps are formed of "hard glass," ending failures due to climatic conditions . . . providing maximum dependability and savings.

For full facts about Amplex Street Lighting Lamps and their superior performance, write Amplex Corporation, Dept. J-3, 111 Water Street, Brooklyn 1, New York.

AMPLEX

Sealed-Beam Reflector Lamps, Colorbeam Lamps, Spotlites and Floodlites, Industrial Infra-Red Heat Lamps, Vibration and Rough Service Lamps, Street Lighting Lamps, Traffic Signal Lamps, Incandescent Lamps, Fluorescent Tubes, Display Accessories.

equipment stocks. The galvannealed outdoor device has an extruded top which is threaded for the die-cast interchangeable hub. The correct size of hub for the conduit is screwed into the top endwall. Company reports that an electrical bond and watertight joint is assured. When no hub is needed, a similar die cast closing cap may be inserted which completely seals the opening.

The hubs may be used in other equipment by cutting a hole and using an adapter nut as a lock nut.

Square D Co, 6060 Rivard St, Detroit 11, Mich.

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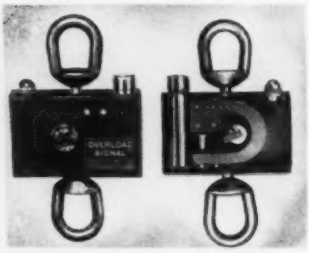


Crane Overload Signal

Setting of a crane automatic overload signal can be made for any point between 500 and 10,000 lb by means of the load setting screw. The completely self-contained unit consists of a U-shaped pressure bar to which is mounted a sensitive microswitch. Should the desired load be exceeded, a red warning lamp lights up and a shrill warning signal is emitted.

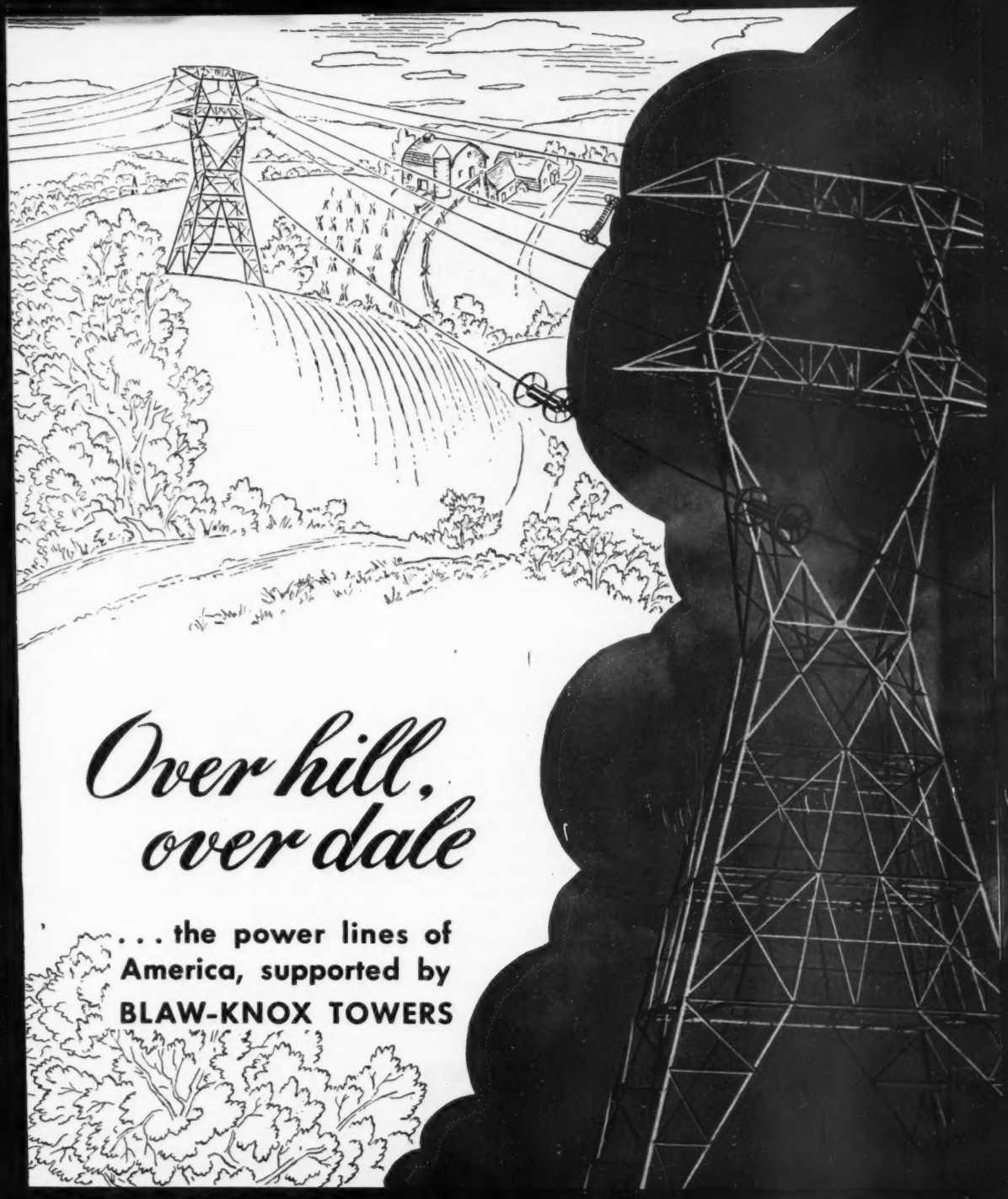
The mechanism is enclosed in a steel housing. Eye-bolts are prevented from turning by means of a special locking arrangement. Power supply is two 1.5-v flashlight cells. This signal is reported to be particularly useful where it is not desirable to cut into the hoist motor circuit when installing the overload warning.

W. C. Dillon & Co, Inc, 1421 South Circle Ave, Forest Park, Ill.

•

Test Data Recorder

Range of a new Speedomax electronic recorder is continuously adjustable over a 20:1 ratio, and zero suppression adjustable over more than twice the maximum range. Through use of a particular suppressed zero range, an operator can ignore that portion of the range in which he is not interested, while he spreads the



Over hill, over dale

. . . the power lines of America, supported by **BLAW-KNOX TOWERS**

BLAW-KNOX TRANSMISSION TOWERS

BLAW-KNOX DIVISION OF BLAW-KNOX COMPANY • 2013 FARMERS BANK BLDG., PITTSBURGH, PA.

NEW YORK CHICAGO PHILADELPHIA BIRMINGHAM WASHINGTON

100 KVA Type F Transformer
2400/120/240

450 KVA, Type F Unit Substation, 4160 V. Delta, 60 Cycles, 3 Ø—120/208Y, 4 wire.

Made by a pioneer in the dry type, air-cooled transformer field. Eliminate need for liquid filled units. No hazardous, inflammable oil or toxic liquid to fuss with. Maintenance of oil level, foreign matter, sludge accumulation, and subsequent filtering are relegated to the "horse and buggy days".

MARCUS DRY TYPE, AIR-COOLED TRANSFORMERS

ARE SAFE — No explosion or fire hazards. No fire proof vaults. Class B and C heat proof insulations.

ARE ECONOMICAL — Lower cost installation and operation, negligible maintenance.

For the transformer that's second to none, specify MARCUS.

ONE OF THE WORLD'S LARGEST MANUFACTURERS OF DRY TYPE TRANSFORMERS EXCLUSIVELY

1 to 2,000 KVA up to 15,000 Volts to meet Individual Requirements

- DISTRIBUTION
- GENERAL PURPOSE
- UNIT SUBSTATION
- PHASE CHANGING
- ELECTRIC FURNACE
- RECTIFIER
- WELDING
- MOTOR STARTING
- SPECIAL

NEMA

Representatives in Principal Cities

MARCUS TRANSFORMERS CONFORM TO THE STANDARDS OF N.E.M.A. AND A.I.E.E.

MC

MARCUS
TRANSFORMER CO.
INC.
30 MONTGOMERY STREET
HILLSIDE 5, NEW JERSEY

PIONEERS IN THE FIELD OF AIR COOLED TRANSFORMERS

few millivolts he wants to watch across the entire width of the instrument chart.

Some typical measurements include:

1. Temperature difference measurements with thermocouples in which small temperature changes are measured at elevated temperatures.

2. Speed measurements using an electric tachometer as the primary element. Speed over a narrow range can be measured, or regulation characteristics of motors, governors, etc.

3. Strain gage measurements for experimental stress analysis, weighing operations, etc.

Calibrated dc millivoltage range is adjustable from a minimum across-chart span of 1.1 mv to a maximum range span of 22 mv. Uncalibrated coarse and fine rheostats provide maximum zero suppression between −50 and +50 mv.

Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

•

SAFETY LAMP—For use inside boilers or furnaces, or in damp locations, the Reel-Lite is available for 110 and 220 v ac, with extension cords of 50 and 100 ft. Standard lamps of 50 to 200 w are used.

Etraco Mfg Co, Inc, Woods Church Rd, Flemington, N. J.

•

Canvas Boiler Covering

Hard-to-get steel plate has been eliminated by a new canvas covering for boilers and other industrial furnaces. The Texad process improves air tightness, reduces enclosure costs, and provides a weather-proof finish. Texad combines a plasticized synthetic resin emulsion, used as an adhesive, with strips of light-weight canvas. The covering seals the unavoidable shrinkage cracks in the finish coat of insulating cement and acts as a safeguard against air leakage

Chemical Brush Control with a

WALLOP!

ESTERON BRUSH KILLER

Yes, Esteron Brush Killer packs a wallop! This hard-hitting Dow formulation (4 pounds acid equivalent per gallon) now contains more powerful type esters of 2,4-D and 2,4,5-T—effective on a wider variety of brush and weeds and *much less* volatile than materials previously available. Easy and economical to use, Esteron Brush Killer gives good control of alder, ash, birch, brambles, cherry, elm, hickory, maple, oaks, osage orange, poison ivy, sumac, willow and other hard-to-kill species. It is effective also in controlling resprouting of stumps when it is applied in oil immediately following cutting.

A wealth of information on clearance and maintenance of right-of-ways and vegetation control around substations, pole yards, booster stations and along fence rows is yours on request. Dow sales and technical men are available for consultation and assistance. Write for Booklet IN-168 on "Vegetation Control."

Agricultural Chemical Division

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

Also recommended for woody plant control is Esteron 245. For controlling grasses such as Johnson, quack and Bermuda—use Dow Sodium TCA 90%. No fire hazard—and treated foliage will not poison grazing cattle. Ask your dealer or write direct.

USE DEPENDABLE DOW AGRICULTURAL CHEMICAL PRODUCTS

WEED, BRUSH AND GRASS KILLERS • INSECTICIDES
FUNGICIDES • PLANT GROWTH REGULATORS
GRAIN AND SOIL FUMIGANTS • WOOD PRESERVATIVE

DOW

CHEMICALS

INDISPENSABLE TO INDUSTRY AND AGRICULTURE

4 things to look for when you need a new black-and-white print machine

NO EXHAUST DUCTS. Bruning BW machines do not use a vapor developer nor emit fumes, thus they need no exhaust ducts. You merely roll them on their casters to wherever they are needed, connect them to your electric circuit and they are ready to make prints.

LESS MAINTENANCE. Craftsmanship and top-quality materials mark every Bruning machine, and pay off in reduced maintenance. All essential bearings are self-aligning permanently lubricated ball-bearings, and bearing shafts are ground to a .0002" tolerance. The adjustable speed drive is a simple, foolproof, patented transmission that runs for years without attention. Welded torque tube braces provide rigidity, assuring exact roller alignment despite uneven floors. Every part requiring servicing is accessible in minutes.

FLEXIBILITY. Bruning machines can handle *any* black-and-white print job. The *unrivalled* variety of Bruning sensitized papers, acetates, films and cloths assures you of complete flexibility. Six different BW machines offer a complete range of speeds and capacities for your every requirement.

COPYING "KNOW HOW" Specialists in copying since 1897, Bruning introduced the black-and-white print to this country in 1929. We manufacture 85 varieties of sensitized papers, films and cloths—far more than any other supplier, and our four coating plants are strategically located to guarantee fresh materials to all sections of the country. Servicing facilities and distribution are nationwide.

See for yourself why Bruning BW copying machines are best. The coupon will provide you with a demonstration or explanatory booklet without obligation. *Send it today.*

BRUNING

Specialists in copying since 1897.

CHARLES BRUNING COMPANY, INC.

Dept. E-31 100 Reade St. New York 13, N. Y.

☐ Please send me information on Bruning BW machines.

☐ I would like to see a Bruning BW machine demonstrated.

Name_____ Title_____

Company_____

Street_____

City_____ Zone_____ State_____

America's largest utilities use Bruning BW copying machines like this Model 93 to turn out thousands of square feet of black-and-white prints every day.

caused by the insulation's own porosity. Outdoor boilers are completely protected against rain, snow, and sleet.

Bigelow-Liptak Corp, 2842 W. Grand Blvd, Detroit 2, Mich.

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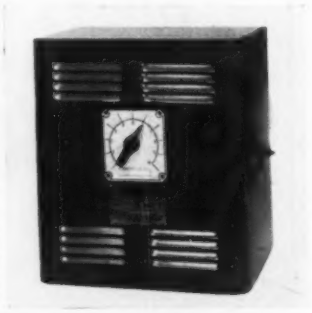

Spot-Welding Control

Air-cooled thyratron tubes make and break the welding current in new synchronous and non-synchronous control equipment for low-capacity, spot-type resistance welding machines. There are no moving parts. The units can be mounted on or near the welding machine.

Synchronous units can be supplied in ratings to 50 amp rms at a 10% duty cycle. Non-synchronous units are available in ratings to 100 amp at 10% duty cycle.

Westinghouse Electric Corp, P. O. Box 2099, Pittsburgh 30, Pa.

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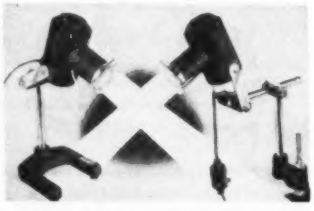


Industrial Spot Lamp

An intense uniform beam of light for close work is projected by an adjustable industrial lamp. A variable size spot of light ranging from ⅝ in. to 3 in. diam is obtained by sliding the focus tube back and forth. Manufacturer states that the lamp has a two-lens condensing system and reflector.

It is suggested for shadow-free illumination for objects being examined with stereoscopic and toolmakers' microscopes, magnifiers, and

your hand can't slip

with the *NEW O.Z.* MALE THREAD BUSHING

"As practical as chains on an icy road." That's what you'll think as you spin one of these type BB insulating Bushings home. Ribbed outer surface lets slippery hands get a firm grip, permits that final tap with a screwdriver for a tight fit.

Wherever you have insulating cables passing through metal boxes or troughs, you'll find that this type BB molded canvas impregnated bakelite Bushing with its smooth rounded edges completely protects wire insulation.

You'll find other features too—features that explain why the O.Z. BB Bushing is better!

- *Clean deep threads let you spin on the bushing with a twist of the wrist.*
- *Fully approved by Underwriters' Laboratories. Meets all requirements of the National Elec. Code.*
- *Available in sizes ½" to 6".*

Try the O.Z. type BB insulating Bushing. Examine their smooth protective edges, their easy moving threads, the way their non-skid ribs fit in your hand. You'll see why economical O.Z.'s are better bushings.

TYPE ABB
Couple the BB with the O.Z. type A insulating Bushing for smooth insulation of a rough knockout.

TYPE BBL
The BB can also be supplied with locknut for positive knockout insulation.

Buy O.Z. and you'll see why Engineers say, "They're OK if they're O.Z."

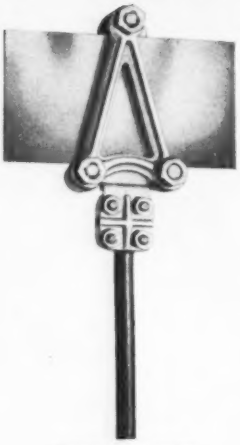
CONDUIT FITTINGS
CAST IRON BOXES
SOLDERLESS CONNECTORS
CABLE TERMINATORS
GROUNDING DEVICES
POWER CONNECTORS

O.Z. ELECTRICAL MANUFACTURING COMPANY, INC.
262 BOND STREET · BROOKLYN 2, N. Y.

7605

SMALL BUT IMPORTANT

Power connectors are amongst the smallest devices that go into a power system. Nevertheless failure of even one connector can be costly. Use of reliable Three E power connectors is one way of avoiding a lot of trouble.



Bar tap for tapping 4/0 cable to 4" bar

Three E Clamp Style Power Connectors are:

1. Accurately designed as to cross sectional and contact areas.
2. Made of high grade copper or copper alloy with high strength alloy bolts.
3. Carefully Manufactured.
4. Easy to install. (Only a wrench is needed).

These features plus time tested performance give assurance that you will

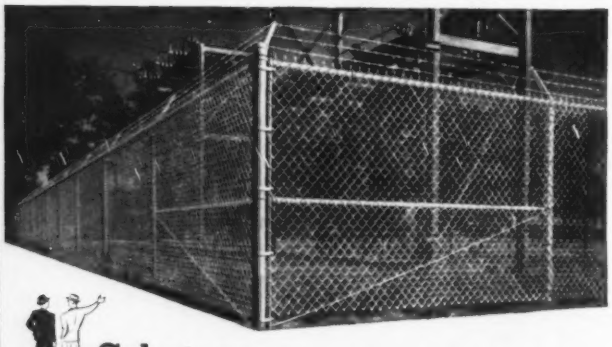
KEEP THE POWER FLOWING WITH THREE E POWER CONNECTORS

Ask for Bulletin 401.

ELECTRICAL ENGINEERS EQUIPMENT CO.
MELROSE PARK, ILLINOIS

PAGE FENCE - Since 1883

• AMERICA'S FIRST WIRE FENCE •



Sabotage is a danger which calls for vigilance day and night. Property line vigilance is the job for Page Chain Link Fence, now as it has been for more than 60 years. Consult the nearby, long-experienced Page Fence engineering and erecting firm, which will submit cost estimates without obligation. Name and address will be sent with illustrated fence data on request.

Write to PAGE FENCE ASSOCIATION in Monessen, Pa., Atlanta, Bridgeport, Chicago, Denver, Detroit, Los Angeles, Philadelphia, New York or San Francisco.

PRODUCT OF PAGE STEEL & WIRE DIVISION OF AMERICAN CHAIN & CABLE COMPANY, INC.

loupes. Other applications are for profile grinding and milling, engraving, assembly of small parts, and sharpness of cutting edges.

Lindly & Co, 80 Herricks Rd, Mineola, L. I., N. Y.

MORE NEW PRODUCTS
about which you should know

Westinghouse Electric Corp, P. O. Box 2099, Pittsburgh 30, Pa., has developed a new **water heater** whose element ratings can be changed to any required wattage between 600 and 3,000 w by shifting wiring connections. . . . American-LaFrance-Foamite Corp, Elmira, N. Y., has announced a pressurized one-quart **fire extinguisher** for class B and C fires in motors, trucks, and other equipment involving small oil and grease fires. Vaporizing liquid is discharged by compressed air.

United States Gasket Co, Teflon Products Div, P. O. Box 93, Camden, N. J., is fabricating all types of Teflon **insulators** for high-voltage, high-temperature, high or UHF service in radio, TV, and other electrical equipment. . . . Ark-Les Switch Corp, 51 Water St., Watertown 72, Mass., is making a pushbutton **range switch** for 5-heat and 7-heat control of top plate and oven heating in electric ranges; 15 amp, 125/250 v ac.

Enco Manufacturing Co, 4522 W. Fullerton Ave, Chicago 39, Ill., is making a flexible portable **electric light unit** which is held with a 50-lb pull to flat or curved surfaces by its permanent magnetic base; accommodates a 25 or 40-w bulb.

Sciaky Bros, Inc, 4915 W. 67th St, Chicago 38, Ill., has announced Model PMCO2ST **resistance welder** for spot welding aluminum, magnesium, stainless steel, Incomel, Monel, brass, mild steel and other alloys. It is rated at 100 kva, 220/440 v, 3-phase.

Fairchild Aircraft Div, Hagerstown, Md., has developed a "thermostatograph" for checking the operating points of eight heater switches at a time. . . . Master Rule Mfg Co, Inc, Middletown, N. Y., has a 50-ft field tape, the Master Longboy-050, which rewinds in 10 sec.

WHY VICTOR PINTYPES KEEP DISTRIBUTION COSTS DOWN

RUGGED, THICK CROSS SECTION gives maximum strength and resistance to impact.

LARGE RADIUS TOP AND SIDE WIRE GROOVES make hot-tieing easy and quick.

SMOOTH CONTOUR *plus* smooth, hard glaze give unsurpassed self-cleaning characteristics—ideal for contaminated areas.

MAXIMUM LEAKAGE DISTANCE conserves current, helps maintain rated voltage, and minimizes outages.

EACH VICTOR LOW-VOLTAGE PINTYPE is individually inspected at every point of manufacture.

HIGHEST QUALITY WET PROCESS PORCELAIN provides highest dielectric and physical strength.

VICTOR NO. 5 LOW-VOLTAGE PINTYPE. For complete engineering data on this insulator and other sizes and types, write today for Bulletin No. 4.

These are only a few of the reasons why VICTOR Low Voltage Pintype Insulators are famous for performance *and* economy. They last longer—give *extra* years of service—cut line maintenance costs to a minimum. Power men everywhere prefer VICTOR Pintypes!

Do You Know that...

The first wet process porcelain insulators were produced at Victor in 1893. In fact, many of our skilled craftsmen have been making high quality porcelain insulators at Victor for over 40 years.

Specify

VICTOR PINTYPE INSULATORS

VICTOR INSULATORS, INC. VICTOR, N. Y.

Built Better At Highway To Do The BIG JOBS Better

Highway is America's major supplier of public utility line maintenance equipment. To produce it successfully is a job that can be done only by craftsmen long trained in this specialty.

Highway equipment has a reputation for being just a little better on every count. What's responsible for this is, we believe, something beyond engineering understanding and the finest in production facilities. It is an attitude—the unrelaxing determination to produce only the very best.

The body shown above, which carries a full crew to the job comfortably, plus all materials and equipment needed, is an example. It can be customized to incorporate *your* ideas, or purchased as you see it here.

We build all types of utility truck bodies—for general or special service of all kinds. See your Highway representative, call, or write.

HIGHWAY TRAILER COMPANY • Headquarters, Edgerton, Wis.

Plants at:
Edgerton, Wis.
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HIGHWAY TRAILERS

Manufacturers of Utility Truck Bodies —Earth Boring Machines—Pole and Cable Reel Trailers —Winches—Power Take-Offs—Service Accessories — Commercial Trailers, Trailerized Tanks and Truck Tanks.

DESIGNED, BUILT, SERVICED— *"Just a little better"*

CATALOGS • BULLETINS

● CIRCUIT BREAKERS: Bulletin 5004D describes Tyes EQ and ET thermal magnetic molded case circuit breakers for overcurrent protection of lighting, distribution, and power circuits of 125 to 600 v ac and dc. Interrupting capacities are from 5,000 to 25,000 amp. I-T-E Circuit Breaker Co, 19th and Hamilton St, Philadelphia 30, Pa.

● WIRING: A comprehensive manual, No. 16-200, on remote-control wiring gives a complete, detailed technical description of the low-voltage control system. For the customer, an 8-page non-technical booklet, 16-330, gives a picture story about remote-control wiring and a simple explanation of how it works. General Electric Co, Construction Materials Dept, Bridgeport 2, Conn.

● SLIMLINE FIXTURES: Fixtures utilizing 200-ma slimline fluorescent lamps in five basic designs with 18 dimensional variations appear in a new informational sheet, C-5010. Colonial Electric Products, Inc, East Paterson, N. J.

● BLOW-OFF VALVES: Bulletin B-433 covers blow-off valves for high pressure boilers, including seatless valves, hard-seat valves and unit-tandem valves for pressures to 2,500 lb. Yarnall-Waring Co, Mermaid Lane, Philadelphia 18, Pa.

● RELAYS: Information on relays, shaded-pole motors, and timers is in Catalog 109. Both pictures and schematic drawings are included. Potter & Brumfield, 221 N. Main St, Princeton, Ind.

● PAINT-BONDING: Technical Service Data Sheet contains information on phosphate coating chemicals and process for paint-bonding, rust proofing, protection of friction surfaces, and improving drawing and extrusion. American Chemical Paint Co, Ambler, Pa.

● FIRE EXTINGUISHMENT: "The Fundamentals of Fire Extinguishment" explains the combustion process, Class A, B, and C fires, and characteristics of flammable liquids. Ansul Chemical Co, Marinette, Wis.

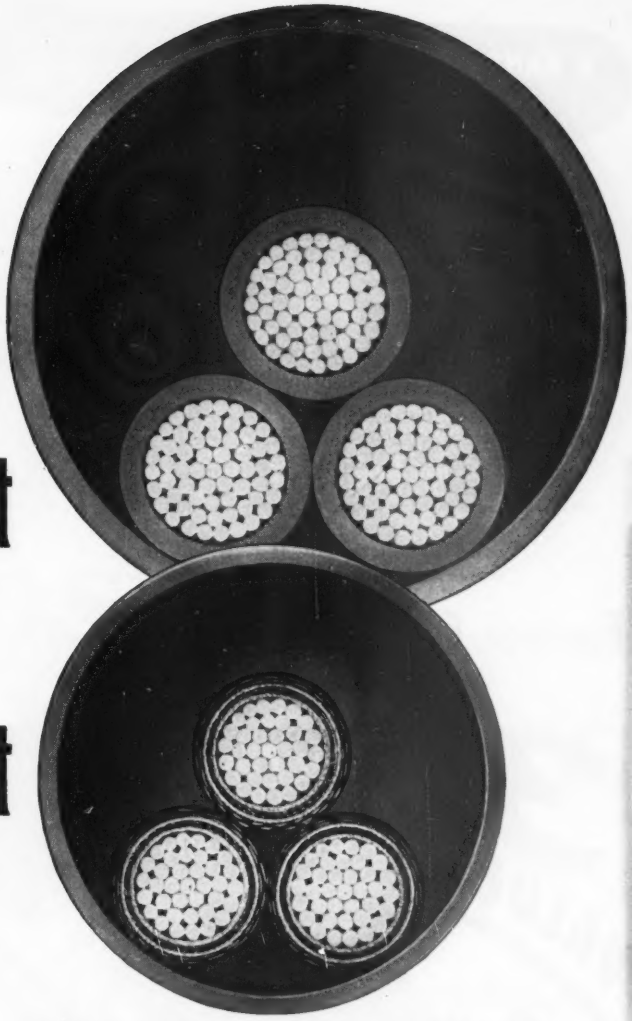
● WELDING ELECTRODES: A 56-page guide, Bulletin R7-8, covers all P&H welding electrodes. There is a description of each electrode, typical applications, and sizes available. Harnischfeger Corp, Welding Div, 4400 W. National Ave, Milwaukee 14, Wis.

● CRANES: Four-page illustrated Booklet S-151 describes briefly the line of super cranes, Hi-Lift cranes, electric hoist cranes, Hi-Lift hoists, and Travelators. Northern Engineering Works, 2615 Atwater St, Detroit 7, Mich.

● RURAL SUBSTATIONS: Substations built up from standardized components for rural distribution systems are described in a 12-page booklet, B4697. Combinations of the various parts described cover over 95% of all rural substation requirements. Six of the more common substation arrangements are shown pictorially. By folding over extended pages, different combinations of parts are shown on the basic layout. Westinghouse Electric Corp, P. O. Box 2099, Pittsburgh 30, Pa.

● ELECTRICAL EQUIPMENT: Stock List 102 is the latest compilation of new and rebuilt electrical equipment in the company's stock. Listed are dc and ac motors, 3-phase squirrel cage motors, totally enclosed, slip-ring motors, ac and dc vertical motors, crane motors, m-g sets, transformers, starters, etc. Glow Electric Co, 933-943 Harrier St, Cincinnati 3, Ohio.

Why Buy 4" Conduit when 3" Conduit will do?



INSTALLED COSTS ARE LOWER

*with high-rated ROCKBESTOS A.V.C.® and a 430 Ampere Load**

- you buy 25% *smaller* conduit
- you use 38% *smaller* cable
- you use *smaller* fittings and lugs
- you have lower labor costs because smaller, lighter cable and conduit are quicker and easier to handle.

To save money specify *permanently-insulated* Rockbestos A.V.C. Write for the booklet "The Story of An Insulation."

*Comparison made with Type RH based on Chapter X, National Electrical Code, 40°C-104°F Ambient

ROCKBESTOS A.V.C.

ROCKBESTOS PRODUCTS CORPORATION, NEW HAVEN 4, CONN.

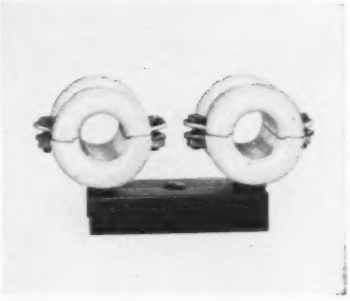
NEW YORK CLEVELAND DETROIT CHICAGO PITTSBURGH ST. LOUIS LOS ANGELES OAKLAND, CAL.

A HANDY POWER WIRING DEVICE

The "Three E" CLAMP INSULATOR SUPPORT is a handy and most useful device in power wiring.

It is easy to install, economical in price and "Three E" has ample stocks to provide prompt shipment.

They are available for insulated conductors ranging from 5/16" to 3½" outside diameter, for pipe or flat mounting, single or multiple conductor.



In factories, mills, mines, power and substations, vaults etc., they make an ideal device for supporting cable runs and all open wiring.

Send for bulletin 201. It describes, illustrates and dimensions the complete line.

ELECTRICAL ENGINEERS EQUIPMENT CO.
MELROSE PARK, ILLINOIS

3 VALUES!

★ One-Piece Construction
★ Wide Wire Range
★ Economically Priced

BLACKBURN *Hi-Strength* **TERMINAL LUGS**

Strongly constructed—all in one piece—yet small and compact to fit in small quarters. Ideal for indoor meter and switch connections, and other indoor uses. Only six sizes cover a range from No. 14 to 1,000,000 CM. Economically priced, too. Investigate this quality lug today.

JASPER BLACKBURN CORP., 35 Madison St., St. Louis 6, Mo., CEntral 3007

TECHNICAL LITERATURE

Steam Turbine Specifications—*Specifying a Mechanical-Drive Steam Turbine* contains many suggestions for preparing purchase specifications for direct-connected or gear mechanical-drive service. Sections of Publication TU3-1950 pertain to features and accessories, rating and design conditions, detail specifications; a proposal bid data sheet is included. Copies may be had for 75¢ from National Electrical Manufacturers Association, 155 E. 44th St, New York 17, N. Y.

Story of Aluminum—*The A-B-C's of Aluminum* is divided into three principal sections: Production and fabrication of aluminum and alloys, the advantages of aluminum, and the uses—and potential uses—of aluminum. There is a series of 69 pictures and charts arranged to present a pictorial story showing how aluminum is produced from raw ore, and carrying on through the fabricating operations. There is a 32-page condensed edition with complete text, but no illustrations, available to schools, engineering societies and others desiring quantity distribution. The full 96-page book will be sent free of charge to anyone in the metal-working industry requesting it on a company letterhead by Reynolds Metals Co, 2500 S. Third St, Louisville 1, Ky.

Stud Welding—The chapter on "Stud Welding" from the third edition of the *Welding Handbook* has been reprinted in a 16-page illustrated booklet. The article explains the stud welding method of fastening, describes the equipment and its principal uses, and gives stud locating procedures and other data. Uses for stud welding include boilers, electrical switchgear, and heat treating equipment. The reprint is available upon request from the Nelson Stud Welding Div, Morton Gregory Corp, Lorain, Ohio.

Metallic Rectifiers—*Standards for Metallic Rectifiers* is divided into five parts: Definitions, Standards for Copper-Oxide Rectifier Cells and Stacks, Standards for Selenium Rectifier Cells and Stacks, Standards for Metallic Rectifiers Used for Industrial Truck Battery Chargers, Standards for Electroplating Metallic Rectifier Units. Copies of Publication MR1-1950 may be ordered for $1.50 from National Electrical Manufacturers Association, 155 E. 44th St, New York 17, N. Y.

Electrode Identification—All arc-welding electrodes for which a standard identification has been established are listed in *Color Markings for Electrode Identification*. The electrodes listed are to be identified either by the color markings specified, or by American Welding Society classification numbers imprinted on the coating. Price of Publication EW2-1950 is 25¢ from National Electrical Manufacturers Association, 155 E. 44th St, New York 17, N. Y.

Locknuts—*Types of Locknuts and Their Principles of Operation* pictures the different types, describes the nut and its operation, and states manufacturers of each type. The booklet is published by Locknut Section, Industrial Fasteners Institute, 3648 Euclid Ave, Cleveland, Ohio.

Spectrochemical Analysis—Metals for which data is listed in *Report on Standard Samples for Spectrochemical Analysis* include these: aluminum and its alloys, copper alloys, iron and steel, and electrode materials. There are a total of 1,077 standard samples and pure substances entered in the report. Technical Publication 58 B may be had for $1.25 from American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.

The cost of life! Westinghouse fluorescent lamps last 7500 hours ...yet cost no more!

Long life? You bet! 2½ years in stores . . . over 3 years in one-shift factories and offices. This means fewer lamp replacements . . . lower maintenance costs! So specify Westinghouse next time you need fluorescent lamps.

YOU CAN BE SURE... IF IT'S Westinghouse

Lamp Division,
Westinghouse Electric Corp.
Bloomfield, N. J.

Send me more information on how I can save with Westinghouse fluorescent lamps.

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EW

CORNELL-DUBILIER CAPACITOR

field performance records!

4.9 BILLION KVAR/HRS. of trouble-free service for PACIFIC GAS & ELECTRIC

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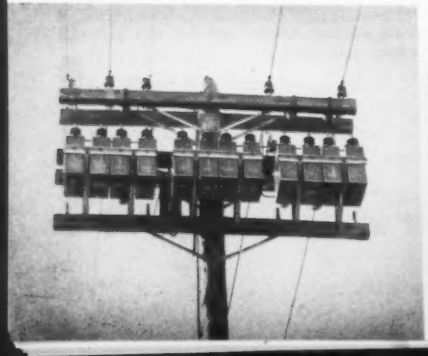
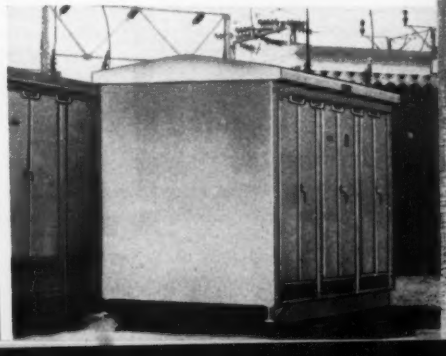
491 MILLION KVAR/HRS. of trouble-free service for T.V.A.

7 BILLION KVAR/HRS. of Capacitor service for PUBLIC SERVICE ELECTRIC & GAS OF NEW JERSEY

These field reports from six great power producers cover the performance of a few C-D capacitor installations that have been in continuous operation for over a decade. They are indicative of the world-wide dependable service records established by C-D capacitors for utility and industrial power-factor correction, service voltage stability and over-load relief. In each case, the record is one of service year after year, with little or no maintenance — a real tribute to the rugged money-saving dependability of the Cornell-Dubilier capacitor.





FOR POWER-FACTOR IMPROVEMENT

HERE'S *WHY* C-D'S mean more value for your capacitor dollar!

Solderless service connector — A C-D Exclusive! Easy to replace. No danger of stripping or distorting the bushing stud and thereby ruining an otherwise perfect capacitor.

Bushing assembly rigidly secured by 7/16" Brass Stud — designed to withstand heavy service abuse.

Dykanol-filled bushing increases accepted flash-over safety factor. Insures high level of impulse withstand.

Heavy-duty, multi-petticoat, wet process, glazed porcelain bushing. Longer creepage path, less breakage hazard, high impulse rating.

Embossed, rigid cover prevents flexing and stress on bushing. Provides water shed.

Bushing designed to prevent gasket deformation. Assures permanent hermetic seal of unit.

Varnished double cork gaskets. Provide high pressure seal between bushing and case.

Discharge resistors — safeguard linemen by reducing residual charge to less than 50 volts in 5 minutes.

Terminal discharge resistor connected to each series section, instead of terminal to terminal. Provides effective discharge for each series group and balanced voltage distribution.

C-D capacitors are equipped with current-limiting fuses with high interrupting capacity

Capacitor stack hermetically sealed in container.

Sturdy steel tension equalizing band and rigid end plates. Insure uniform distribution of stack-pressure, still further increasing dependability of unit.

Wide margin maintained between paper and foil coordinated with major insulation to provide highest impulse level.

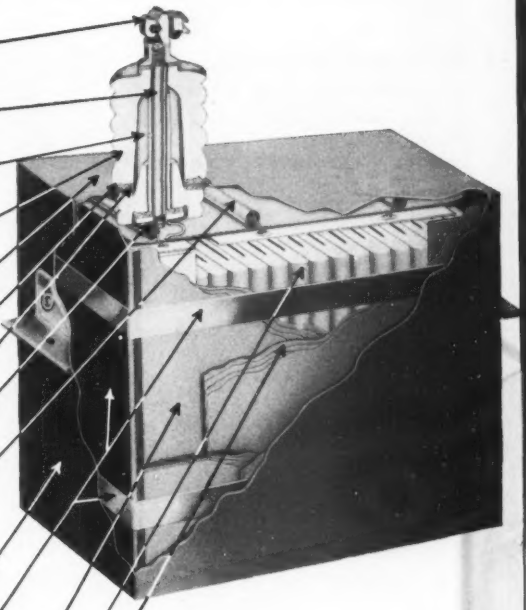
Impregnated and submerged in special non-inflammable, non-explosive Dykanol. Results in lower unit weight per Kvar; high stability; long life; less hazard to accessory equipment.

Many small sections in series parallel connection. Extremely low voltage gradient per section; less heating; no corona; longer life; lower power-factor; lowest dielectric unit stress.

Laminated insulation between case and sections. Insures high safety-factor for test and transient voltages.

Wrap-around bracket — another C-D exclusive! Two wraps extending around sides affording greater safety against impact stress in shipping and handling. That's why C-D racks can be shipped completely assembled, ready for energizing.

All C-D capacitors (from 230 to 13,800 volts), are given an energization test as a form of quality control by applying full rated voltage for minimum period of time sufficient to establish ultimate heat rise. (Only C-D capacitors give you energization tested capacitors!)



Among the many reasons why C-D industrial, station and pole type capacitors have given so many years of trouble-free service under the severest operating conditions is C-D's engineering standard which provides for the lowest dielectric unit stress and highest major insulation level. C-D station-type capacitors can be provided in weatherproof housings, switched or unswitched and completely assembled for energizing at field site, to meet specific sub-station needs. *Your inquiries are cordially invited. Our field engineers will be glad to discuss the many dollar and maintenance saving characteristics of these installations.*

CORNELL-DUBILIER ELECTRIC CORPORATION,
Dept. D-31, South Plainfield, New Jersey.

Other plants in New Bedford, Worcester and Brookline, Mass.; Providence, R. I.; Indianapolis, Ind., and Cleveland, Ohio.

41ST ANNIVERSARY
CORNELL-DUBILIER CAPACITORS
1910-1951

CORNELL-DUBILIER
CAPACITORS
BEST BY FIELD TEST

NEWS ABOUT PEOPLE

Delta-Star Electric Co Appoints New Officers

C. S. Beattie has been appointed executive vice president and general manager of the new Delta-Star Electric Co, now a division of H. K. Porter Co, Inc. R. E. Anderson has been

C. S. BEATTIE

named senior vice president. Both men also were elected directors of the reorganized company.

Beattie will be in charge of all activities of the company. He joined Delta-Star in 1930 as sales engineer in New York. He became assistant sales manager in 1936 and manager of engineering in 1941. Since 1944 he has been vice president in charge of production and engineering.

Before going to Delta-Star Beattie worked at East Pittsburgh for Westinghouse Electric Corp in the general engineering department, for Public Service Production Co in Newark, N. J., and in the switching division of United Engineers & Constructors Co, Inc, also at Newark.

In addition to his duties as senior vice president Anderson will continue to direct the company's sales activities and commercial relations. He went to Delta-Star in 1920 as sales engineer. He was named assistant sales manager in 1929, sales manager in 1936, and vice president of the manufacturing company in 1941.

Anderson started in the engineering department of Eastern Michigan

R. E. ANDERSON

Power Co in 1913. After a year with Commonwealth Edison Co, he joined H. M. Byllesby Co in its engineering department in 1916.

•

PS of Northern Illinois Realigns Operating Staff

Public Service Co of Northern Illinois has made several new appointments in a realignment of the operating organization.

E. R. Hendrickson has been appointed manager of construction. New manager of engineering is G. S. Bartlett, and new manager of stations and substations is Murray Joslin, both of whom were assistants to the vice president in charge of operations. H. C. Kalwitz, formerly in charge of maintenance, was appointed assistant manager of construction, and M. E. Luckey, assistant to the northern division vice president, was named administrative engineer.

Bartlett joined the company in 1919, became district manager at Pontiac, Ill., in 1925, and since then has held a number of operating posts. Joslin served as superintendent of substations, general power supervisor, Maywood, Ill., division manager, and division vice president before becoming an assistant vice president. Hendrickson has been Northbrook, Ill., division engineer, division operating superintendent, and manager of the division electrical operating department for the utility.

General Electric Supply Makes Stringham a VP

Warde B. Stringham has been elected commercial vice president of General Electric Supply Corp. He will be the company's representative in Washington.

Stringham has been in the electrical

W. B. STRINGHAM

business since 1927. He started in Salt Lake City, was president of his own appliance company in Des Moines, was sales manager of W. D. Alexander Co in Atlanta, and in 1934 became president of Southern Appliances, Inc, at New Orleans.

When the company was sold to GE Supply in 1936 he continued at New Orleans as district manager. A year later he was transferred to Washington as Chesapeake district manager.

•

J. Shirley Gracy, vice president of Florida Power Corp, has been named to head the sales department. In his new duties he will supervise and coordinate activities of the residential, commercial, industrial, and community development departments. He will continue active supervision of personnel relations.

Whipple Jacobs, president of Phelps Dodge Copper Products Corp, has become chief executive officer of the company with the retirement of **Wylie Brown,** chairman of the board. Brown has been in the copper fabricating

This Steel-Service Team for Electric Utility Requirements

Convenient to electric power and light companies from coast to coast, thirteen Ryerson steel-service plants stand ready to supply these utilities and their equipment manufacturers.

True, shortages resulting from the twin pressures of defense requirements and unprecedented civilian demand may make it impossible for us to furnish every item on every order, much as we would like to. But it is likely that many of your requirements are among the carbon, alloy and stainless steels we have on hand for prompt shipment. And experienced Ryerson steel men are always glad to work with you—help you make the most of available steel.

From switchboard to shipping floor all of us are ready to give you prompt service whenever humanly possible. So call us for every steel need.

PRINCIPAL PRODUCTS

BARS—Carbon and alloy, hot rolled and cold finished, reinforcing bars, etc.
STRUCTURALS—Channels, angles, beams, etc.
PLATES—Many types including Inland 4-Way Safety Plate, Inland Hi-Steel, etc.
SHEETS—Hot and cold rolled, many types and coatings
TUBING—Seamless and welded, mechanical and boiler tubes, structural tubing, etc.
STAINLESS—Allegheny sheets, plates, bars, tubes, pipe, pipe fittings, etc.
BABBITT METAL—Ryerson Glyco in 5 grades
MACHINERY & TOOLS—for metal fabrication

RYERSON STEEL

RYERSON CERTIFIED STEELS

JOSEPH T. RYERSON & SON, INC. PLANTS: NEW YORK • BOSTON • PHILADELPHIA • DETROIT • CINCINNATI
CLEVELAND • PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO

Cut Earth Boring Costs WITH THE PENGO EARTH AUGER

"You'd be surprised where the PENGO Auger will bore!"

A scientifically-designed double helix auger that:

* Bores in any kind of soil, hardpan or decomposed rock
* Bores clean, straight holes of the specified diameters—saves concrete
* Saves power, minimizes wear and tear on your earth boring machine
* Eliminates repair trips to shop... hard-facing expense

"THE MOST PROFITABLE TOOL YOU EVER BOUGHT". Order a PENGO for your present machine... specify PENGO augers with your new machine.

Available in nine diameters to 36" (actual HOLE sizes) for use with all popular makes of earth boring machines.

ORDER TODAY... OR SEND FOR LITERATURE, PRICES

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460 Kifer Road, Santa Clara, California

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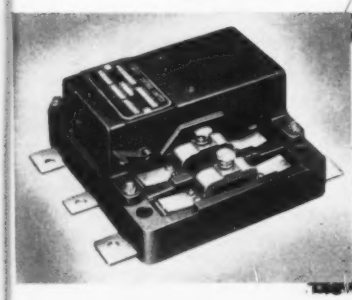


*A CONTROL MUST FOR HIGH BAY LIGHTING

... instant disconnect of lighting and power feeders from remote panel

*THE SWITCH TO PROVIDE THIS SERVICE!

... the ASCO Remote Control Switch now made in capacities up to 1000 amperes

Are you laying out the electrical circuits for a large building—a factory—a hangar—an auditorium—an institution? Buildings with extensive high-lighted working bays?

Instant remote disconnect of lights and power circuits is a "must", if both safety and economy are objectives.

Remote controls for instant disconnect protect workers and machinery. They eliminate multiple heavy feeder lines, thus saving on installation costs.

The ASCO Line of Remote Control Switches, similar to the switch illustrated, now ranges up to 1000 amperes in capacity. Write us about your requirements.

ASCO Automatic Controls

Automatic Switch Co.

397 Lakeside Avenue Orange, New Jersey

Electromagnetic Controls For All Industry

We also manufacture a complete line of Solenoid Operated Valves for Automatic and Remote Control of Liquids and Gases.

business for more than 52 years. He started with Bridgeport Brass Co and was secretary and general sales manager when he left it in 1914. He went on to organize American Copper Products Co, later National Electric Products Corp, of which he became vice president. When Phelps Dodge acquired National in 1930 Brown became vice president, then president, and finally chairman.

Paul V. Hayden has been appointed director of public relations of Connecticut Light & Power Co. He succeeds **Vice President C. J. Allen,** who has retired. Hayden joined the utility in 1929 as a power sales engineer at Danielson after a term of service with Westinghouse Electric Corp. From 1940 to 1947 he was industrial power engineer at Willimantic; then he was transferred to Waterbury as engineer for special assignment on the headquarters sales staff. Named industrial manager in 1948, he became executive assistant in the public relations department early in 1950.

OBITUARY

Lewis R. Brown

Lewis R. (Buster) Brown, 69, manager of General Electric Co's Transformer Divisions from 1923 until his

LEWIS R. BROWN

retirement in 1947, died Feb. 26 at his home in New York City.

Brown joined GE in 1903 and became its first salesman to specialize in transformers. In 1911 he was made head of the distribution section of transformer sales in Schenectady.

He was transferred to Pittsfield, Mass., in 1913 and ten years later was

"Light-Conditioning" program now underway in a big way!

More than 50 electric service companies already planning to tie in!

INTRODUCED only a few short months ago, General Electric's Home Light-Conditioning Program is already getting into full swing. And more and more electric service companies are playing a part. More than 50 electric service companies already have made plans to carry on a Home Light-Conditioning Program in their service areas.

Light-Conditioning—lighting that's up to the newest, most modern standards, with the right bulbs in the right lamps and fixtures, and in the right places—helps your customers get more out of their lighting. It creates a new concept of eye comfort and home beauty. And it is effective for both new homes and old. To learn how you can tie in with the G-E Light-Conditioning Program call your G-E Lamp District Office, or write Lamp Department, General Electric, Nela Park, Cleveland 12, Ohio.

TELLS 40,000 ARCHITECTS AND BUILDERS

This double-page advertisement shows more than 40,000 readers of The Magazine of Building how Light-Conditioning fits into the newest, low-priced homes. It's another example of the extensive promotion that General Electric is putting behind the Light-Conditioning Program.

BIG AUDIENCE FOR LITTLE BOOK

This new General Electric booklet is packed with detailed, how-to-do-it recipes—22 in all—for Light-Conditioning every room in the house. Already more than a million copies have been distributed. Light-Conditioning recipe booklets are available in quantity to Electric Service Companies at nominal cost.

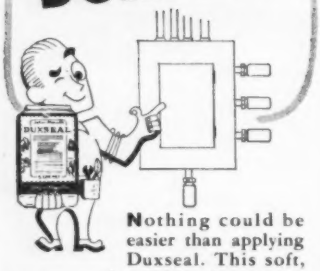
G-E NATIONAL ADS FEATURE LIGHT-CONDITIONING

Your customers are reading about Light-Conditioning in the Saturday Evening Post, Ladies Home Journal, Better Homes & Gardens, Small Homes Guide and other magazines. All these big-circulation publications are making Light-Conditioning familiar to people in your service area.

GENERAL ELECTRIC

HANDY ANDY SAYS:

Pluggin's a soft job . . . with Johns-Manville DUXSEAL



Nothing could be easier than applying Duxseal. This soft, permanently pliable plastic putty goes right into place in openings around service boxes, cable entrances, conduit ends, drill holes in foundations . . . makes a smooth, finished-looking job in a matter of seconds. Every electrician should keep a convenient, handy package of Duxseal in his tool box for on-the-spot use . . .

Remains soft—Duxseal stays soft indefinitely, but will not slump, melt or run under ordinary temperatures.

Remains tight—Clings to duct walls and cables but gives with expansion or contraction of the cable.

Remains insoluble—Unaffected by ground waters and gases.

Remains harmless—Will not injure workmen's hands or react with rubber, metals or painted surfaces.

Tight seals for other electrical uses:

J-M Tranolseal . . . for use with electrical equipment using dielectric oils.

J-M Uniseal . . . for caulking against weather and humidity. Resists temperatures up to 180 F.

If you would like to know more about Duxseal and other J-M labor-saving sealing compounds, write Johns-Manville, Box 290, New York 16, N. Y. In Canada, write 199 Bay Street, Toronto, Canada.

JM

Johns-Manville
SEALING COMPOUNDS

appointed manager of the division, responsible for sales of transformers and allied equipment. Shortly before his retirement he was made manager of the Transformer and Specialty Transformer Divisions.

Brown was a former director of the National Electrical Manufacturers Association and a former vice president of the Electric Power Club.

•

Lewis H. Brown

Lewis H. Brown, 57, chairman of the board and chief executive officer of Johns-Manville Corp, died Feb. 26 at Delray Beach, Fla.

Brown worked for Fort Wayne (Ind.) Corrugated Paper Co and Montgomery Ward & Co before joining Johns-Manville in 1927 as assistant to the president, T. F. Merseles. When the latter died in 1929 Brown succeeded him as president at the age of 35 and in 1946 became chairman of the board.

LEWIS H. BROWN

An exponent of conservative monetary policies, Brown was a member of an advisory committee just named by Economic Stabilizer Eric A. Johnston to aid in solving stabilization problems. In 1947 he toured Germany at the request of the United States Military Government and published a book, "Report on Germany," calling for full economic reconstruction.

Brown pioneered in encouraging self-liquidating mortgages during the depression and was among the first business executives to adopt the 40-hour week and collective bargaining policies and to hold regional stockholders' meetings and make financial reports to employees.

He was vice president of the Freedom Foundation, chairman of the

NOW you can bend Thin-Wall Conduit profitably

Here's the efficient way to bend 1¼, 1½ and 2" electro-metallic tubing. It's done with Blackhawk's remarkable all-directional "Porto-Power" hydraulic unit.

BENDING SHOES create kinkless, wrinkle-free bends matched offsets

There's no crushing. You get 90° bends in just one setting. Remote-operation permits bending on the bench or floor — in the most convenient position for handling, sighting and measuring pipe.

ONLY Porto-Power gives you these benefits

The bending assembly for 1½" conduit weighs only 50 lbs. This means easy handling . . . no wrestling with heavy, clumsy equipment. The equipment pays for itself on the first good job.

Write for free Bulletin No. 50B on Benders for both Rigid and Thin-Wall Conduit . . . plus spectacular HYDRAULIC Knock-Out Punches. See leading wholesalers or write Blackhawk Mfg. Co., Dept. P-4131, Milwaukee 1, Wis.

BLACKHAWK

American Enterprise Association, chairman of the executive committee of Tax Foundation, Inc, and a member of the President's Emergency Committee for Employment in 1930 and 1931. He was the first recipient of the Vermilye Medal of the Franklin Institute in 1939 and received the Medal for Merit in 1946 for his services as adviser to the Army Chief of Ordnance during World War II.

•

Frank G. Vaughen, 76, retired manager of the meter division of General Electric Co, died March 1 at Schenectady, N. Y. after a long illness. He retired in 1942 following more than 50 years with the company. Vaughen began his career in 1891 as a meter tester for Thomson-Houston Electric Co, a GE predecessor at West Lynn, Mass. In 1900 he went to Schenectady as an assistant in the GE meter division. He became manager of the division in 1923.

Thomas L. Paden, general supervisor of electrical operations for Pennsylvania Power Co since 1946, died suddenly at his home in New Castle Feb. 23. He had been with Penn Power and associated companies for 28 years. Paden started as a test clerk for Pennsylvania-Ohio Power & Light Co in 1923 and in 1931 was made electrical superintendent for Pennsylvania Power.

Dennis S. Melvin, manager of the advertising department of Consolidated Edison Co of New York, Inc, died Feb. 27. He worked for Strathmore Paper Co and General Electric Co before joining Con Ed in 1929 as a district salesman. Later he served as manager of the appliance promotion bureau and of the construction contracts bureau.

Albert Angus Richardson, 59, Ontario Hydro Commission engineer and builder of several of the largest power developments in Ontario, died in Toronto Feb. 23. He also had been with George Rayner Construction Co and Morrow and Beatty Construction Co. His major power development work was the Des Joachims project.

Charles E. Gray, 65, works manager of Rome (N. Y.) Manufacturing Co, a division of Revere Copper & Brass, Inc, died Feb. 26 at Boston. He had been with Revere since 1929.

meet an important little wheel..

in big industry...

● And he can be mighty important to you. We're talking about Chicago Printed String Co's. non-woven industrial tape, PRINT-AD-STRING. He's a versatile fellow available in various widths down to ⅛" and in thickness down to .003", any color or combination of colors, and printed with any brand name or information you wish.

FLAT IN FORM . . . MANY SIDED IN APPLICATION!

● **IDENTIFIES:** He identifies thousands of products at the same time that he ties and protects them.

● **OPENS:** He opens tough wrappings with ease when used as an internal rip cord, saves time, gets product acceptance.

● **ADVERTISES:** He advertises thousands of products by name, slogan, and colors, right on the product.

● **SECURES:** He secures insulation barriers between successive coils in transformer windings.

● **TIES:** He ties thousands of coils of hose and tubing securely with no rubbing, or chafing, and at the same time identifies the product.

● **PROTECTS:** He protects precision edged gaskets with his unique ability to stand high tension and stay flat, no rubbing or scuffing.

● **MEASURES:** He measures millions of miles of electric cable, and further identifies it, gives specification information, patent numbers, etc.

WHAT CAN HE DO FOR YOU?

This same tape with special treatment is waterproof, fungus resistant, flame proof and heat resistant. Our Engineering Department stands ready to help you with any problem involving industrial tape, or to design a special tape to meet a special problem. Use the coupon below.

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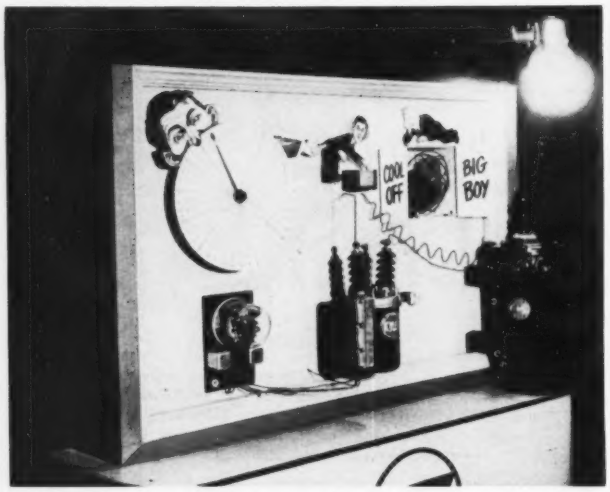
MANUFACTURERS and MARKETS



Long-winded speakers got an effective vacuum treatment when a "Talker-Stopper" (above) devised by Line Material Co engineers went into operation at a recent company sales convention.

"Guaranteed to cut down in full flight any character who became enamored of the sound of his voice and exceeded his allotted time," the device kept the four-day meeting strictly on schedule.

Five minutes before the end of a speaker's time the caricatures on the panel flashed a red warning light while two doors labeled "Cool off, Big Boy" opened to reveal an electric fan in operation.

When time was definitely up a brutal clanging and a brilliant light gave the word. An oil switch activated by an automatic timer closed a circuit energizing one of LM's transformer load alarms (an overload indicating device) mounted in an empty transformer tank, and a street-lighting luminaire cast 2,500 lumens on the panel.

After one or two operations of the "Talker-Stopper" blue pencils began to appear in the hands of yet-to-be-heard speakers.

GE Closing Strikebound Coast Transformer Plant

General Electric Co has announced a "regretful decision" to close its recently modernized Oakland, Calif., transformer plant, strikebound since last October. The plant will be offered for sale and its activities transferred to Holyoke and Springfield, Mass.

The United Electrical, Radio & Machine Workers of America struck the 149,000-sq-ft plant last Oct. 12 when the company proposed a piecework incentive plan. Despite the modernization, the plant has been operating at a loss for some time. The incentive plan, according to GE, has been in use for years in practically all the company's plants and is similar to those in effect at other GE western facilities, also represented by UE.

Opened in 1923, the Oakland plant is the largest self-contained transformer manufacturer in the West, producing units ranging from 1½ to 1,000 kva. Some 325 workers, including 200 UE members, were employed by the plant when the strike began. Production capacity was doubled by the $2-million expansion and modernization program, completed in October, 1949.

IUE to Seek Pay Boosts from Radio, TV Industry

Radio, television, and radio parts manufacturers can expect a major drive for wage boosts of about 20¢ an hour by the CIO-International Union of Electrical Workers. This will be coupled with a big organizing drive.

These were the main decisions of an IUE conference recently. Reports presented by local delegates said that rates in radio and TV plants are about 20¢ an hour less than for comparable jobs in the electrical industry and that only about half the radio-TV industry is organized.

Among other actions the conference agreed to seek uniform wage rates for jobs of the same type, decided to drive for Philco-type pensions with severance pay provisions, and agreed to demand complete company-paid health and insurance programs.

•

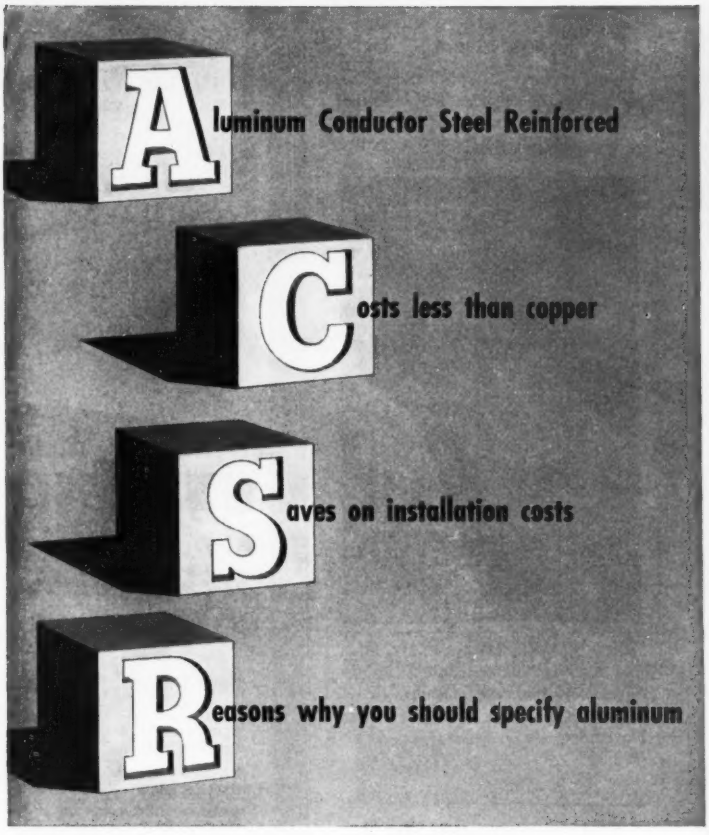
A-C Subsidiary Acquires Canadian Allis-Chalmers

A new wholly owned subsidiary of Allis-Chalmers Manufacturing Co, Milwaukee, Wis., has purchased all the physical assets of Canadian Allis-Chalmers, Ltd. The new subsidiary is known as Canadian Allis-Chalmers (1951) Ltd.

M. C. Lowe, formerly vice president of Canadian Allis-Chalmers, Ltd, has been named president of the new subsidiary. The Canadian firm, which employs approximately 525 persons, will continue production of heavy machinery for the Canadian market. Its plant at Lachine, Que., has been producing hydraulic turbines, centrifugal pumps, Texrope drives, mining machinery, and equipment for the paper industry under a license from A-C.

Metal Prices
March 5, 1951

COPPER, Conn. V., lb	$ .24½
LEAD, N. Y., lb	.17
ZINC, prime Western, E. St. Louis, lb	.17½
TIN, Straits qual., N. Y. lb	1.81¾
ALUMINUM, ingot, base price	.19
NICKEL, base price	.50½
STEEL, billets, Pitts., ton	56.00
STEEL, scrap, No. 1 heavy, Pitts., ton	45.00


Aluminum Conductor Steel Reinforced
Costs less than copper
Saves on installation costs
Reasons why you should specify aluminum

A-B-C of ACSR

THE facts stated above have been demonstrated over and over again. With the result that today more than 80 per cent of all transmission line being built is aluminum.

And the same money-saving facts apply to weatherproof wire for distribution and service lines . . . light, strong aluminum cuts costs all down the line!

Today, more and more Kaiser Aluminum conductor is being specified for these jobs. For, as a major supplier to the power industry, Kaiser Aluminum has built a reputation for quality and service that is unsurpassed.

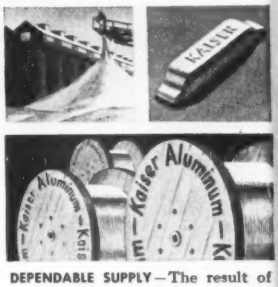
• • •

To help meet critical military needs, Kaiser Alminum has begun a vast expansion program which will greatly increase production of primary aluminum. When conditions permit, the power industry will share in the additional supply.

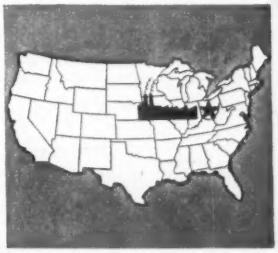
Meanwhile, if you have any conductor problems, call any office listed below.

CONSISTENT QUALITY—Rigid tests at every step in production assure conductor of uniform high quality.

EXPERIENCED PERSONNEL—Men with years of experience in producing conductor help assure that your specifications are met exactly.



DEPENDABLE SUPPLY—The result of completely integrated production facilities—from bauxite processing to finished ACSR.



PROMPT DELIVERY—because of Kaiser Aluminum's convenient location at Newark, Ohio. Also prompt assistance from service personnel.

Kaiser Aluminum

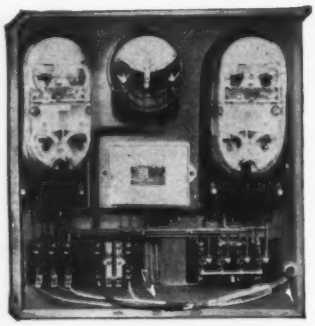
Setting the pace . . . through quality and service

SOLD BY KAISER ALUMINUM & CHEMICAL SALES, INC., KAISER BUILDING, OAKLAND 12, CALIFORNIA
OFFICES IN: Atlanta • Boston • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit Houston • Indianapolis • Kansas City • Los Angeles • Milwaukee • Minneapolis • New York Oakland • Philadelphia • Portland, Ore. • Rochester, N. Y. • Seattle • Spokane • St. Louis Wichita • EXPORT OFFICE, OAKLAND, CALIFORNIA • DISTRIBUTORS IN PRINCIPAL CITIES

KEES

POLYPHASE METER BOXES

L16-W



No. 24-W-2 Front removed

KEES polyphase outdoor meter boxes feature knockouts for all probable hook-ups for polyphase meters, primary metering, time switches, and recording instruments. Front forms more than one-half the sides and bottom. Equipment can be reached from sides as well as from front. Weatherproof, waterproof front is hinged at top, easily detached. Latch may be sealed, and locked.

Write Dept. EW-8 for free catalog.

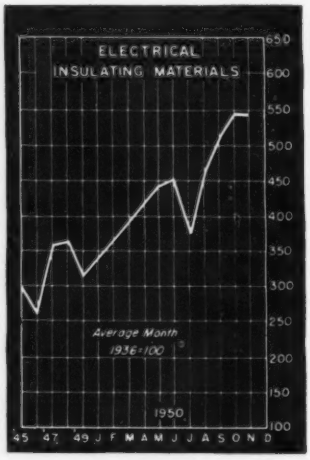
Since 1874

F.D.KEES MANUFACTURING CO.
BEATRICE, NEBRASKA

Insulating Materials Sales Show November Drop

Sales of electrical insulating materials dropped slightly in November from their October record high.

The index of sales billed compiled



by the National Electrical Manufacturers Association declined to 542 in November, 1% below October's 547. Sales for the month were 57% above November, 1949, when the index read 345.

SALES ASSIGNMENTS

COMPANY STAFFS

Trumbull Electric Co, Plainville, Conn., has named J. C. Pascher sales manager for its New York district. He has been manager of the Hartford, Conn., office of General Electric Co.

Westinghouse Electric Corp's Central Station Division has transferred Donald R. Jenkins to Salt Lake City, Utah, from Los Angeles, Calif.

General Electric Supply Corp has divided its Chesapeake district into two districts with headquarters at Washington and at Baltimore. Arthur L. Aiken has been appointed manager in Washington and J. Walter Turner in Baltimore. Charles W. Webster becomes assistant district manager at Baltimore.

Worthington Pump & Machinery Corp, Harrison, N. J., has made W. A. Finn general European manager. Since his return from World War II naval service he has been manager of the export department.

REPRESENTATIVES

T. J. Cope, Inc, Philadelphia, has appointed E. S. Stickle Co, 1150 Union Trust Bldg, Pittsburgh, representative in western Pennsylvania.

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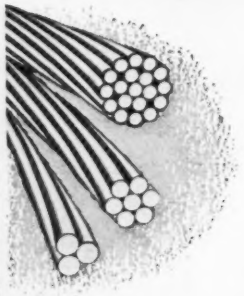

Stainless Steel
STRAND
AND
Stainless-Copper
CONDUCTORS

Here's WHY they Save

Compared with other types strand of equal breaking strength, they . . .

- have 30-40% greater overload capacity within elastic limit.
- resist corrosion all the way through—not merely through a thin case of soft metal.
- offer highest tensile and vibration-fatigue strength (tensile strength 235,000 psi; corrosion-fatigue limit 50% of ultimate).

Here's HOW they Save

- They permit longer spans—therefore require fewer poles per mile.
- Being lighter, they are easier and faster to install in the field.
- More resistant to destructive factors, they last many times as long before replacement.

Let us tell you the whole story—

specific data, prices, recommended sizes.

ACCO
Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Los Angeles, New York, Philadelphia, Portland, San Francisco, Bridgeport, Conn.

PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE

NEW ELECTRICAL CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Alabama—Clarke-Washington Electric Membership Corp., Jackson, 252.17 mi. rural distr. lines, Clarke and Washington Counties. Plans deposit $10. Lanier Eng. Co., Troy, Ala., engr.

Calif., Stanford—Stanford University, office of Bus. Mgr., 1 story, 20,200 sq. ft., electronics bldg. Spencer & Ambrose, 251 Kearny St., San Francisco, archts.

Colorado—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, 1 station-service switchgear assembly and 1 transformer and voltage-regulator assembly for system dispatchers' bldg. at Flatiron, near Loveland, Larimer Co. L. N. McClellan, ch. engr.

Conn., Stamford—Conn. Light & Power Co., 36 Pearl St., Hartford, power plant.

Ia., Eddyville—Iowa Southern Utilities Co., Centerville, power plant, **$8,000,000.** H. W. Bender, c/o owner, distr. engr. Edward de Rivera, c/o owner, ch. operating engr.

Minn., Austin—City Bd. Water, Electric, Gas & Power Comrs., W. D. Dunlap, secy., municipal power plant, incl. coal and ash-handling equip., instrument and combustion control, piping and elec. equipment and wiring, $82,000. Plan deposit $20, J. V. Edeskuty, 1418 Foshay Tower, Minneapolis, engr.

Minn., Worthington—City, G. S. Thompson, clk., furnish, del. 10,000 kv. turbine generator unit, 12,000 sq. ft. surface condenser, auxiliary equip., switchgear and tile transformer at municipal power plant, $400,000. Pfeifer & Shultz, 702 Wesley Temple Bldg., Minneapolis, engrs.

Montana—Bureau Reclamation, Fort Peck, approx. 16 mi., Fort Peck-Glasgow Bench, 69 kilovolt, 3 phase, single-circuit, wood-pile, H-frame type transmission line, Fort Peck Dam in northeast portion of Montana, Fort Peck Proj., Spec. DC 3322; installing 2 overhead ground wires and bayonets, on approx. 35 mi. Fort Peck Wolf Point section of Fort Peck Glendive 115 kilovolt transmission line, Fort Peck Proj., Spec. DC 3329.

Montana—Northeastern Montana Rural Telephone Corp., Medicine Lake, Mont., telephone lines for 1,675 customers, in Valley, Sheridan, Daniels, Roosevelt, Divide and McCone Counties, **$1,500,000.** Central Eng. Corp., Sidney, Mont., consult. engrs.

Neb., Omaha—Omaha Public Power Dist., 17 and Harney Sts., power plant to house new immense turbine. Approx. **$300,000.** Burns & McDonnell Eng. Co., 95 and Troost Sts., Kansas City, Mo., consult. engrs. Minard, c/o owner, ch. engr.

N. Y., Utica—General Electric Co., River Rd., Schenectady, electronics equipment plant, 1 story, steel frame plant, 2 story office. **$15,000,000.**

Oklahoma—U. S. Eng., P. O. Box 61, Tulsa, Zone 1, 2 traveling cranes and switchboards for Tenkiller and Fort Gibson, Muskogee Co. $125,000. Plans deposit $10.

Oregon—U. S. Eng., 19 E. Poplar St., Walla Walla, Wash., station service control boards, main control boards and general control cubicles for McNary Dam, Inv. No. CIVENG 45-164-51-36.

Pa., Phila.—Dpt. Property & Supplies, 1400 J 9 St., Harrisburg, imprv. electrical distr. sys. at Phila. (Byberry) State Hospital. Plans deposit $10. General Industries, Inc., 311 S. Broad St., engr.

Pa., Phoenixville—Philadelphia Electric Co., 900 Sansom St., Phila., 6 story electric generating plant. **$27,000,000.** United Engineers & Constructors, Inc., 1401 Arch St., Phila., consult. engr.

Tex., Houston—Houston Lighting & Power Co., 1016 Walker St., reconstructing portion outside heavily wired pole lines. **$500,000.**

Alaska—Golden Valley Electric Assoc., Fairbanks, Alaska, 80 mi. rural distr. lines and sys. imprvs., Golden Valley Co. **$800,000.**

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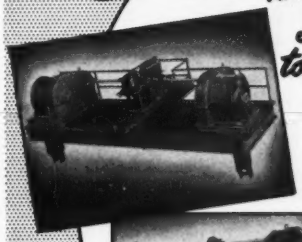

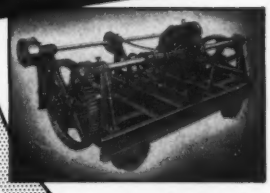

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Low Bidders & Contracts Awarded

Calif., Burbank—C. C. Moore & Co., First and Mission Sts., San Francisco, Calif., Low Bidder, **$873,099**, steam GENERATING UNIT and AUXILIARY UNITS for Unit 4, municipal power plant, Spec. 501. City, City Hall, Burbank, Calif.

Calif., El Centro—Macco Corp., 14409 S. Paramount Blvd., Paramount, Calif., Contract Awarded, **$382,198**, 161-kv transmission line for Parker line exten., between Drop 4, and El Centro switching station, Spec. 340. Imperial Irrigation Dist., El Centro, Calif. Awarded Feb. 16.

Combustion Engineering - Superheater, Inc., 200 Madison Ave., New York, N. Y. Contract Awarded. Total cost **$85,000,000**, 4 giant BOILERS. JOPPA, ILL. Electric Energy Inc., c/o J. W. McAfee, pres., 135 N. 12 Blvd., St. Louis, 1, Mo.

Louisiana, Mississippi, Alabama, Georgia, South Carolina and North Carolina—Westinghouse Electric Corp., 306 Fourth Ave., Pittsburgh 30, Pa. Contract Awarded. **$600,000**, electrical equipment contract for expansion sys. incl. switchgear, motor starters, control centers, ventilating fans, pipe lines from Baton Rouge to Bremen. Plantation Pipe Line Co., (Standard Oil Co. of New Jersey, Standard Oil Co. of Kentucky and Shell Oil Co.) Healey Bldg., Atlanta, Ga. Bids Feb. 15.

Oklahoma—Walco Eng. Co., Tri-States Bldg., Tulsa, Okla. Contract Awarded. **$476,142**, est. $475,000. 44 mi. 66 kv transmission line, Lindsay to Anadarko, Garvin Co. Southwestern Power Admin., P. O. Drawer 1619, Tulsa 1, Okla. Awarded Feb. 21.

Tenn., Oak Ridge—Maxey & Leftwich, Lubbock, Tex., Contract Awarded. **$330,225**, est. $301,215. K-25 LABORATORY Bldg. No. K-1413. U.S. Atomic Energy Comn., P. O. Box E, Attention R. J. Dunbar, Engineering Div., Oak Ridge, Tenn. Bids Feb. 12.

Tex., Dalngerfield—Brown & Root, Inc., Box 3, Houston, Tex., Contract Awarded, Approx. **$750,000**, lighting plant, lighting sys., INDUSTRIAL FACILITIES, **$390,000**, open drainage and earthwork; **$375,000**, gas sys.; **$600,000**, streets and roads, and area paving; **$400,000**, sewerage sys., sanitary and drainage; **$175,000**, water sys. Lone Star Steel Co., E. B. Germany, 4152 Mockingbird Lane, Dallas, Tex. Grand total $3,080,000.

Va., Woodbridge—F. H. Martell Co., 1023 20 St., N. W., Wash., D. C. Low Bidder, **$1,061,800**, transmitting station, near U. S. Eng., First and Douglas Sts., Wash., D. C.

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Ill., Crystal Lake—Crystal Lake Bd. Educ., plans by Childs & Smith, 20 N. Wacker Dr., Chicago, Zone 6 brick, concrete, steel, stone community high school **$2,000,000**.

La., Baton Rouge—Solvay Process Div. Allied Chemical & Dye Corp., North Baton Rouge, soda ash chemical plant unit, **$2,750,000**.

N. Y., Jackson Heights—Bulova Watch Co., Inc., 62-10 Woodside Ave., Woodside, 3 story watch assembly plant, on 24 acre site bounded by Astoria Blvd. south, 77 St., 25 Ave. and Brooklyn-Queens Expressway east. **$3,000,000**.

Low Bidders & Contracts Awarded

Ill., Madison—United Engineering & Foundry Co., 948 Duquesne Way, Pittsburgh, Pa. Contract Awarded, continuous ROLLING MILL for magnesium sheet; Austin Co., 16112 Euclid Ave., Cleveland, O., rehabilitating plant and installing equipment. Total est. **$26,000,000**. Dow Chemical Co., Midland, Mich.

N. J., Gibbstown—E. I. du Pont de Nemours & Co., Inc., du Pont Bldg., Wilmington, 98, Del. Own forces. Repauno PLANT EXPANSION.

Cauldwell-Wingate Co., 101 Park Ave., New York 17, N. Y. Contract Awarded. **$19,016,400**, est. $20,656,981. Veterans hospital, first Ave. and 23 St., New York, N. Y. U. S. Eng., 80 Lafayette St., New York 13, N. Y. Bids Feb. 20.

Tenn., Memphis—E. I. du Pont de Nemours & Co., Inc., du Pont Bldg., Wilmington, Del. Own Forces, hydrogen peroxide PLANT, Fite St. and Hy. 51.

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Frequency Reduction

(*Continued from page* 102)

variation and with the bus voltage maintained constant. Changes in frequency will affect the voltage regulation between the generating station and the load and thereby the voltage at the customer, depending on the relative effect of the circuit constants and the character of the load. Variations in the composition of the load will materially affect the results obtained by frequency reductions.

System Interconnections . . . Interconnecting ties, within and between systems are depended upon for substantial blocks of reserve capacity. In an emergency if the sustained loads on these ties exceed safe overloads they may have to be tripped out, to prevent damage. Loss of this tie support may result in a complete shutdown of the area in trouble. To retain full tie support it is therefore necessary to reduce the load demand of the deficient area.

Load Relief . . . Having recognized and ascertained the limitations of plant or system capacity the Consolidated Edison Co has in force a load relief procedure which may be put into effect by the system operator at any time he deems necessary. Depending upon the amount of relief required he may reject load by reducing system voltage or by dropping blocks of load.

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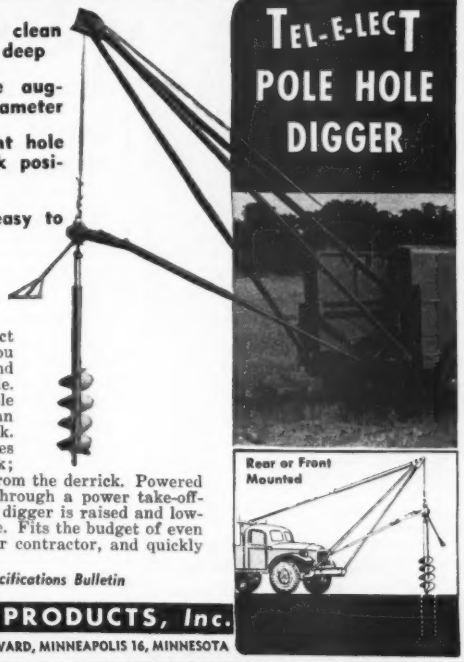

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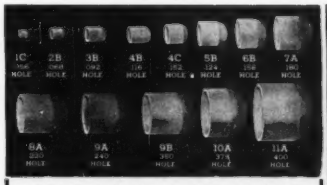

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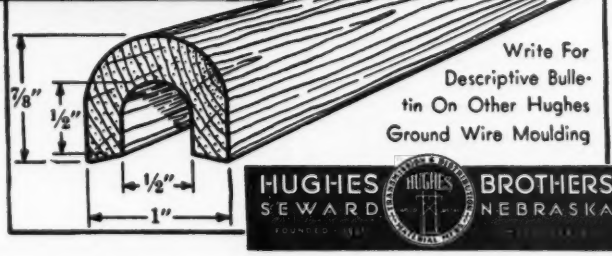

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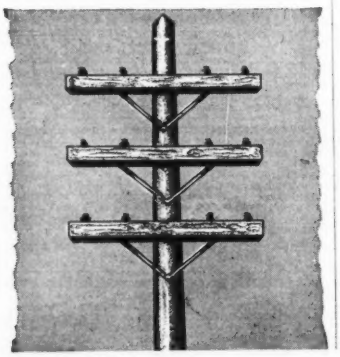

Costs Favor Radial

(*Continued from page* 99)

highest and lowest voltages at the consumer would be approximately the same as the Department's radial system now supplies.

Radial System . . . Study of a comparable radial system was prefaced by a study of the feasibility of bus regulation for the type district being considered. Method was to determine service that would be given by bus regulation of a group of existing feeders of conventional design, then modification necessary to furnish satisfactory service to all customers concerned. The study showed, on groups of five feeders with balanced phase loads installed with no thought of bus regulation, that under present loading, bus regulation would maintain voltage at secondary service connections within 115-123 v. If load on all feeders developed to full rated capacity it would be necessary to replace 2/0 conductors, now in use on some feeders, with 4/0 conductors. By regrouping the feeders not more than two out of fourteen would require supplemental regulation, although cost estimates assume two of each six feeders to have feeder regulation.

Service from the primary network was found to be comparable in most respects to that from the major station and radial system. Choice therefore rested largely upon economic factors. As with secondary network in the downtown area, costs are substantially more than for radial distribution with a major distributing station—$2,609,000 against $1,775,000. Inclusion of maintenance costs for the station would further increase the cost of the primary or secondary network schemes.

Site Difficulties . . . An additional disadvantage of the network system is the need for more sites. Stations would require special attention to limit transformer noise, and would have to conform to architectural and landscaping treatment of the neighborhood to obtain approval of the city planning commission and zoning administrator.

Station finally selected for the area has 34.5-kv feed and a 5,000-v bus-regulated radial system supplied from three 12,000/15,000/20,000-kva 3-phase transformers. Normally the

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load will be carried split equally on three bus sections each individually regulated by a tap changing under load transformer. Each bus section will have five and ultimately six 4,800-v feeders.

Provisions for Regulators . . . It appears that acceptable voltage conditions will be provided by bus regulation alone, at least in the initial stages. The design provides, however, for installation of six regulated feeders, two per bus section, if and when unknown future developments may require them. Cost estimates include regulators in these feeders.

Radial Wins Out . . . As a result of the studies the Department has adopted an expansion program including at least three 40,000-kva stations with bus regulation, two with provision for individual regulation of up to six out of eighteen feeders if required.

For conditions existing in Los Angeles, there seems to be no justification for installation of either a secondary or primary network system.

Glass Bulb Rectifiers

(*Continued from page* 93)

vide protection against minimum ambient temperature, specified as 6 deg C. Normal operating range for the equipment is 10-30 deg C; heating of the air below 10 deg C is desirable to facilitate vaporization of the mercury.

Fuse Protection . . . High rupturing capacity, non-expulsion type fuses with renewable fusible elements in the anode circuits give effective protection against arc backs. When one small unit was hit by lightning, 11 of the 12 anode fuses blew; when they were replaced the unit was placed back in service immediately.

Balancing, Smoothing Output . . . Adjustable choke coils in series with each anode provide a means of balancing current distribution between anodes and between bulbs operating in parallel. Balancing is done during initial test operation of the units by varying the air gap in the laminated iron core of the variable reactor. Using a clip-on ammeter, fiber spacers are added to or removed from the magnetic circuit and the currents can be balanced down to less than 10% load.

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DOW CORNING 4 COMPOUND

MEETS ALL REQUIREMENTS OF AN-C-128a

More water repellant than paraffin, Dow Corning 4 Compound is highly resistant to oxygen, ozone and to deterioration caused by corona discharge.

POWER FACTOR up to 10 megacycles . . 0.001

VOLUME RESISTIVITY ohm centimeters . . . . 10^15

DIELECTRIC STRENGTH volts/mil 500

for switches and contacts in the POWER INDUSTRY

for ELECTRONIC EQUIPMENT

Write Today! for your copy of our new booklet on Dow Corning 4 Compound. Address Dept. I.

Dow Corning FIRST IN SILICONES

DOW CORNING CORPORATION, Midland, Michigan

SEARCHLIGHT SECTION

(Classified Advertising)

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$1.20 a line, minimum 4 lines.
To figure advance payment count 5 average words as a line.

Employment Wanted and Individual Selling Opportunity undisplayed advertising rate is one-half of above rate, payable in advance.

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An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches—to a page.

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CHICAGO: 520 N. Michigan Ave. (11)
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WANTED: ENGINEER, electrical or mechanical, some experience power and/or distribution transformers, exceptional opportunity. Box 687, Pine Bluff, Arkansas.

POWER ENGINEER for large Eastern utility company. Outstanding opportunity for graduate mechanical engineer about 25 with practical experience in steam turbine power plant operation including technical ability to handle mechanical, steam and heat transfer matters incidental to design and operation of power plant equipment. Send full details. J. T. Jennings, 241 Orange St., New Haven 10, Conn. (Agency).

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SALARIED POSITIONS $3,500 to $35,000. We offer the original personal employment service (established 41 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered, present position protected. Ask for particulars. R. W. Bixby, Inc., 262 Dun Bldg., Buffalo 2, N. Y.

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(Classified Advertising)

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ENGINEERS

ELECTRICAL - MECHANICAL - STRUCTURAL

Openings in Ohio and New York offices offering long term employment with good salary for qualified Group Leaders, Designers and Draftsmen experienced in one or more of the following phases of industrial plant design:

Electrical Power, lighting layouts and electrical controls.

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Please submit complete resume stating experience, education, salary required and availability date.

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Engineers and Builders

The Ferguson Bldg. 1783 E. 11th St. Cleveland 14, Ohio

19 Rector Street New York 6, N. Y.

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Chicago office of well-known architect-engineer firm of Skidmore, Owings & Merrill, has immediate openings for experienced men in various capacities in Production Department. Wide variety of work.

Executive position for heating, ventilating, and air conditioning engineer, to take charge, as assistant to head, of Mechanical Engineering Department of 50-60 engineers and draftsmen.

Mechanical Specifications Writer experienced on plumbing, heating, and electrical work.

For Appointment
Phone Randolph 6-2527
or write

SKIDMORE, OWINGS & MERRILL
Architects-Engineers
100 West Monroe Street
Chicago 3, Illinois

Wanted Sales Supervisor

Sales manager for old established Michigan manufacturer of electric power apparatus desires to employ a staff assistant to supervise all activities and procedures of sales headquarters.

Prefer man with technical experience and sales background, with knowledge of electric utility operations.

Excellent salary to start. Advancement opportunities for right man.

In reply give complete details of age, education, and experience.

P-9160, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

ELECTRICAL DESIGNERS

ESTABLISHED BOSTON CONSULTANTS HAVE OPENINGS FOR ELECTRICAL ENGINEERS AND DESIGNERS WITH POWER PLANT AND INDUSTRIAL DESIGN EXPERIENCE.

P-7852, Electrical World
330 W. 42nd St., New York 18, N. Y.

GOT POWER PROBLEMS?

Make Your Own!

FOR SALE: Fairbanks-Morse 3 cylinder, 210 hp, diesel engine with A-C generator. This style VA diesel engine, operating at 300 rpm, is mounted in line to generator with continuous rated capacity of 97 KW; percentage power factor equals 80; amperes per terminal, 291; temperature rise, 52 degrees; KVA rating, 112.5—3 phase, 60-cycle, 240-volts hooked up with exciter to produce alternating current.

OHIO VALLEY PACKING CO.
371 East Fifth Street Chillicothe, Ohio

SCHOOLS

A COMPLETE HOME COURSE IN
ELECTRICAL CONTROL
Write for full particulars to
ELECTRICAL INSTRUCTIONS
DEPT. 106
P. O. Box 5177 Audubon Station
Baton Rouge 6, La.

EMPLOYMENT SERVICE

SALARIED PERSONNEL $3,000-$25,000. This confidential service, established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. L, 241 Orange St., New Haven, Conn.

SELLING OPPORTUNITY WANTED

AGGRESSIVE COMPANY of Sales Engineer with New York headquarters having successful record selling to utilities, government agencies, contractors and industrial customers eastern seaboard and Washington seeks additional lines. RA-9092, Electrical World.

OFFICIAL PROPOSALS

Bids: July 2, 1951

Steel Pipeline(s) and Associated Works

DEPARTMENT OF THE CO-ORDINATOR-GENERAL OF PUBLIC WORKS, BRISBANE, QUEENSLAND, AUSTRALIA
TULLY FALLS HYDRO-ELECTRIC PROJECT
SPECIFICATION NO. TF/5

Tenders closing at Noon on the 2nd July, 1951 at the Office of the undersigned, are invited for the manufacture, supply, delivery and erection of

(a) a steel pipeline (No. 1) and associated works

and alternatively

(b) the penstock system complete comprising pipelines Nos. 1 and 2 and associated works

for the Tully Falls Hydro-Electric Project in North Queensland.

Particulars may be obtained from Australian Consulate-General, 636 Fifth Avenue, New York 20, New York, from whom copies of plans and specifications are available on payment of a sum of Two Dollars and Twenty-four cents ($2.24). Cheques should be made payable to "Commonwealth of Australia".

The lowest or any tender will not necessarily be accepted.

Tenders should be endorsed "Tender—Hydro-Electric Project, Steel Pipeline and Associated Works".

C. E. PETERSEN
SECRETARY
DEPARTMENT OF THE CO-ORDINATOR-GENERAL OF PUBLIC WORKS
Box 185C, G. P. O.
BRISBANE, Queensland, Australia

Bids: July 2, 1951

Pressure Tunnel and Surge Tank

DEPARTMENT OF THE CO-ORDINATOR-GENERAL OF PUBLIC WORKS, BRISBANE, QUEENSLAND, AUSTRALIA
TULLY FALLS HYDRO-ELECTRIC PROJECT

SPECIFICATION NO. TF/6

Tenders closing at Noon on the 2nd July, 1951, at the Office of the undersigned are invited for the construction of a pressure tunnel and surge tank for the Tully Falls Hydro-Electric Project in North Queensland.

Particulars may be obtained from Australian Consulate-General, 636 Fifth Avenue, New York 20, New York, from whom copies of plans and specifications are available on payment of a sum of Two Dollars and Twenty-four cents ($2.24). Cheques should be made payable to "Commonwealth of Australia".

The lowest or any tender will not necessarily be accepted.

Tenders should be endorsed "Tender—Hydro-Electric Project, Pressure Tunnel and Surge Tank".

C. E. PETERSEN
SECRETARY
DEPARTMENT OF THE CO-ORDINATOR-GENERAL OF PUBLIC WORKS
Box 185C, G. P. O.
BRISBANE, Queensland, Australia.

NEW
Guaranteed Rebuilt
MOTORS-GENERATORS-CONTROLS
NOW IN STOCK
We buy surplus equipment
L.J. LAND Inc.
Box 756 Reading-5 Pa.

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3–150 K.W. DIESEL GENERATOR SETS

Buckeye–600 r.p.m.–medium speed Westinghouse generator–440/3/60–complete with modern dead front switch gear. Units equal to new–used only 50 hours.

IMMEDIATE DELIVERY

Write—Wire—Phone

THE

BOSTON METALS CO.

313 E. Baltimore Street

Baltimore, Md.

LE 1900 CU 5050

DIESEL POWER

FOR

IMMEDIATE SHIPMENT

UNIT CAPACITIES—10 TO 1875 KVA

A.C.—50 AND 60 CYCLES

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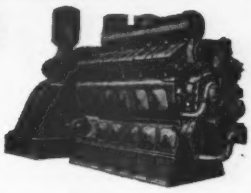

A PARTIAL LISTING OF OUR INVENTORY

KVA	Make	Model	HP	RPM	KVA	Make	Model	HP	RPM
1875	Fairbanks Morse	32F16	3000	300	375	Enterprise	DSG-6	450	450
1420	Fairbanks Morse	38D8¼	1600	720	330	Superior	ENA	396	514
1250	General Motors	16–278A	1600	720	312	General Motors	8–268A	450	1200
937.5	General Motors	12–567	1060	720	312	Clark	MD–4	375	327
635	Alco	6–12½x13T	750	600	187	Ingersoll Rand	8	225	514
434	Baldwin	VO–6	510	450	125	General Motors	5–268A	150	1200
409	Buckeye	80	480	600	75	General Motors	6045C	90	1200

D.C. UNITS ALSO AVAILABLE

A. G. SCHOONMAKER COMPANY, INC.

ENGINE DIVISION, 50 CHURCH ST., NEW YORK 7, N. Y.

FROM AVAILABLE STOCK

TURBO GENERATORS

Qu	KW	Make	Desc.
2	750	G.E.	Condensing — 425 lbs. 750 TT. I.S.P. 440V. 3 ph. 60 cy —Built 1944
1	625	Westg	Non-cond. 125 lbs. I.S.P. 5/30 lbs. B. P. 440 v. 3 ph. 60 cyc.
1	400	Westg.	Non-condensing—125/150 lbs. I.S.P. 5/10 lbs. B.P.—240/480 v. 3 ph. 60 cy.
1	300	G.E.	Non-condensing 150/175 I.S.P. 5/10 B.P.—480 v. 3 ph. 60 cy.

SYNCHRONOUS CONDENSERS

	KVA	Make	Type	Volts	Speed
1	5140	Whse.		2400/4150	600
1	4000	G.E.	TSC	2400/4150	900
1	3000	Whse.		2400/4800	720

MOTOR GENERATOR SETS

3 ph. 60 cy.

Qu	KW	Make	Speed	DC Volts	AC Volts
2	2000	G.E.	500	600 25 cy	11000
1	1500	G.E.	600	125/250	2300/4150
1	1500	G.E.	360	275	2300/4400
1	1000	Whse.	900	600	4150
1	1000	G.E.	900	600	2300/4150
1	750	G.E.	900	275	4150
1	750	Whse.	900	275	2300/4150
1	600	Whse.	900	250	440
1	500	G.E.	720	125	2300
1	400	G.E.	720	250	440/2300
1	350	G.E.	900	125	4150

TRANFORMERS—60 Cycle

	KVA	Make	Type	Ph	Voltages
2	2666	Whse.	OISC	1	66000x11000
3	1250	G.E.	HVDDJ	1	6600x600
1	600	Al. Ch.	OISC	3	2300/4150x270/440
3	333	Pitts.	OISC	1	26400x2600
6	250	G.E.	HT	3	13200x240/480
12	250	G.E.	HT	3	2400/4150x240/480

BELYEA COMPANY, INC.

OFFICE & SHOP

51 Howell St., Jersey City 6, N. J.

45,000 kw POWER PLANT

and

4 MILL-TYPE BUILDINGS

immediately available

Located on the main line of a trunk railroad, adjacent to low-cost fuel in the Appalachian bituminous coal area, in the center of excellent labor supply, this industrial plant on a 20-acre site is ready for immediate use. Power plant equipment includes:

Four 11,250 kw Westinghouse turbines, each capable of 11,000 volts, 25 cycle, 1500 rpm.

Fourteen Stirling boilers, stoker-fired, each capable of 50,000 lb steam per hour, 700,000 lb per hour total, 225 psig, 150°F.

Complete coal and ash-handling facilities.

All of the buildings, the power plant, and the utilities on the site are well maintained. Power capacity can be doubled by modernization at a relatively small capital outlay. Nearby properties available for plant expansion.

K. S. DENNY

340 Lantana Avenue Englewood, N. J.

ETHYL CORP.

– OFFERS –

FOR SALE: 2 each used 4 panel, 200 volt, 3 phase, Westinghouse Distribution Switchboards, completely assembled with equipment and 2 each used 4 panel, 440 volt ditto. Purchased new 1938 and 1940 and made obsolete by plant expansion. Good condition. For additional information contact.

ETHYL CORPORATION

Purchasing Department

Box 341 Baton Rouge, Louisiana

–TRANSFORMERS–

BOUGHT AND SOLD

We carry a large stock of transformers, and invite your inquiries.

PIONEER TRANSFORMER REBUILDERS

We rewind, repair and redesign all makes and sizes. *One Year Guarantee.*

THE ELECTRIC SERVICE CO., INC.

"AMERICA'S USED TRANSFORMER CLEARING HOUSE"

SINCE 1912 CINCINNATI 27, OHIO

J. L. HEMPHILL & CO.

ELECTRICAL ENGINEERS & EQUIPMENT

Tron St. & 51 NORTH BERGEN, N. J. N. Y. C. Tel. Longacre 5-3[illegible] N. J. Tel. N. B. 5-[illegible]

TRANSFORMERS

1—1500 KVA G.E., 3 Ph., 4150V, 2300V Pyranol
1—1000 KVA G.E., 3 Ph., 4150V, 2400V
1—1000 KVA G.E., 3 Ph., 4150V 2 Ph., 2400V
2—400 KVA G.E., 1 Ph., 2600V, 2300V Sec
3—250 KVA Maloney, 1 Ph., 13,800V, 240/480 Sec
1—150 KVA G.E., 3 Ph., 4150V 120/208Y
1—75 KVA G.E., 3 Ph., 2400V, 240/480V Sec.
6—50 KVA G.E., 1 Ph., 13,480V, 120/240V Sec.

WELDERS

2—500 Amp. Westinghouse Flex Arc Welders 220/440 sing. phase

MOTOR GENERATOR SETS

2—1500 KW G.E., 600V, 600 RPM, 4000V Syn.
2—1250 KW G.E., 275V, 600 RPM, 4000V Syn.
1—1000 KW G.E., 600V, 514 RPM, 4000V Syn.
1—150 KW G.E., 125/250V, 1200 RPM, 2300 Syn.
2—75 KW G.E., 250V, 1200 RPM, 220V Syn.

SLIP RING MOTORS

1—2500 HP G.E., WT, 257 RPM, 6600V
1—300 HP G.E., WT, 600 RPM, 4400V

SYNCHRONOUS CONDENSER

1—2500 KVA Whse., 720 RPM, 2200V with D.C. Exc.

Large Stock of A.C. and D.C. Equipment

LETTERS TO THE EDITOR

New Type of Distribution

To the Editor:

We appreciate the compliment you pay us in using Greenwood as the primer in your ad ("Printers' Ink," December, 1950). I cannot resist . . . on another matter that I have written to "Electrical World" about in the last few months—the day of the old standard overhead pole line distribution on city streets is over. This was shown at Summit, N. J. in, I believe, 1947 or 8. The Great Storm (as my daughter-in-law in Syracuse called it) has only proved it. Aerial cable and underground as described in your Nov. 20 issue or something besides the old crossarm and TBWP must come quickly if we are to continue in business . . . I am still hoping you will start a discussion on a new type of distribution system for the storm battered East and Middle West.

F. W. Chapman
Superintendent
Commissioners of Public Works
Greenwood, South Carolina

(Editor's note: To provide information for such a discussion, "Electrical World" is surveying power companies in the storm area.)

New Female Champ?

To the Editor:

In reading your October 9, 1950 copy of "Electrical World" I find in the Letters to the Editor column an article regarding female meter readers.

We have with us at the present time a Mrs. Mattie Lee who has been reading meters continuously since August 10, 1942. She has been reading approximately 7,000 meters per month in all kinds of weather and has a very excellent record.

I am enclosing a picture of Mrs. Lee that was taken while she was reading meters at Kelso, Washington, March 1949.

Howard L. James
Commercial Assistant
Cowlitz County PUD
Longview, Wash.

(Editor's Note: Step up ladies—any longer service records as meter readers?)

METER READER—Mrs. Mattie Lee

DBPC For Oil Reclamation

To the Editor:

On page 68 of the February 26, 1951 issue of Electrical World, I was quoted in paraphrased form as saying to the Electrical Equipment Committee of EEI on February 12, "DBPC supply is on the verge of being cut off because of extensive Government needs for military purposes". This is not quite accurate. The statement I actually made relative to availability which is identical with the statement made at Atlanta by C. E. Sutton, Jr, of the General Electric Co (see Electrical World, same issue, page 66) is as follows:

"We have just been informed by our principal suppliers of insulating oil that there is now and will be in the foreseeable future a critical shortage of the inhibitor, DBPC. Of the available supply, the first preference must obviously be given to military needs which involve substantial quantities for use in lubricating oil on military propulsion equipment, hydraulic systems, aircraft, etc. Another vital usage for DBPC is in turbine oil. In view of this situation and the fact that no one can afford to have apparatus shipments held up for lack of oil, it appears desirable to terminate as soon as practical the use of DBPC in oil for new transformers and allied products, and we are taking the necessary steps to do so.

"In addition to the fact that there is not an adequate supply of DBPC for our transformer needs, we have been confronted with another situation. During the short period that we have been using DBPC oil for transformers and other equipment, there has developed considerable opposition on the part of a number of utilities to the use of inhibited oil in transformers prior to a decision as to whether such oil is satisfactory for use in circuit breakers. These companies find that the problem of handling separate oils for transformers and switchgear is a difficult one.

"The studies on inhibited oil in switchgear are still under way, but until the studies are completed, the use of inhibited oil in circuit breakers has not yet been authorized.

"At a later date when DBPC is again available in the quantities required for complete usage, the situation will again be reviewed. At that time, we shall probably also have much more complete knowledge of the behavior of inhibited oil in switchgear and the recommendations of switchgear manufacturers as to such usage."

Although I did not state so at the meeting, it should be obvious that supplies of DBPC for use in *reclaimed oil* would be much more readily available because G.E. as a large user of transformer oil would not be taking substantial quantities of DBPC.

Although I have no way of foretelling future situations, my impression is that there will be an adequate supply of DBPC for all *reclamation work under way or contemplated.* If the situation were one where a decision had to be made as to whether the inhibitor were to be used for reclamation purposes or for new equipment, it would seem that the reclamation purposes would or should have the preference since much of the old oil is used in equipment without modern oil preservation methods.

I feel it is desirable in the interest of clarification to give this more complete presentation of our action and I trust you will print this letter in its complete form with that objective.

H. M. Jalonack,
Manager
Marketing and Sales Promotion Div
Transformer and Allied Product Div
General Electric Co
Pittsfield, Mass.

INDEX TO ADVERTISERS
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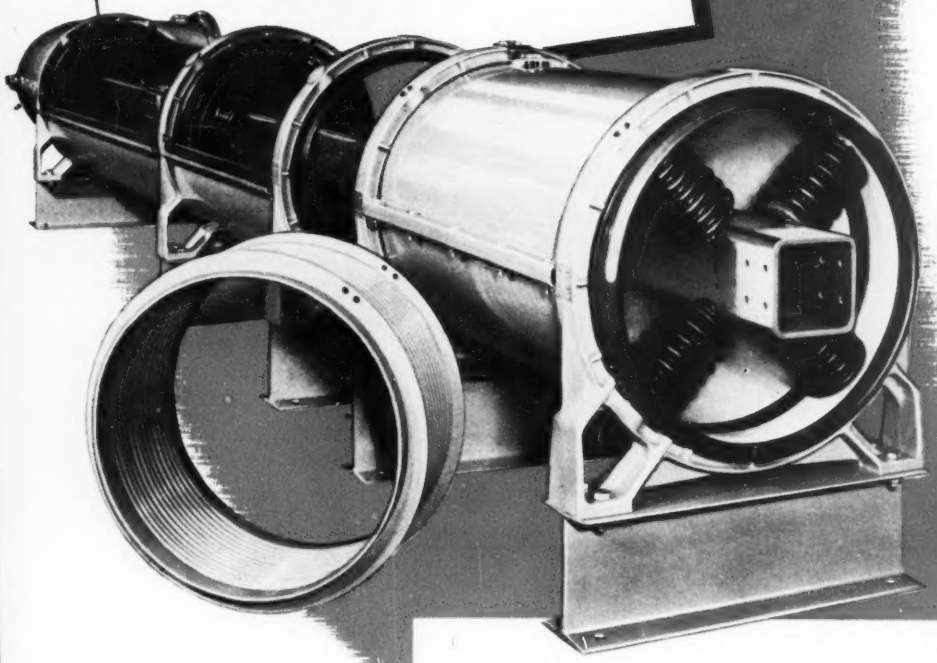
A DIRECT PATH TO BETTER PROTECTION

DELTA-STAR

ISOLATED PHASE METAL ENCLOSED BUS DUCTS



A typical section of an isolated phase bus; rated 13.8 kv., 4500-amperes.

DELTA-STAR METAL-ENCLOSED BUSES ARE AVAILABLE FOR ALL REQUIREMENTS

"Unit-Type" metal-enclosed bus designs are available in a wide variety for isolated phase, segregated phase and non-segregated phase construction. Delta-Star's experienced engineers will make an analysis of your proposed installation and determine which type will be the most economical for your service requirements. Regardless of the type selected, you are assured of a design which will fit into your installation at low erection cost.

For complete information ask for Publication 5006.

Here is the safest direct path between generator and station bus or transformer. Its actual value far exceeds its initial cost. Maintenance is reduced to a minimum. Absolute isolation of each phase eliminates the possibility of a phase to phase fault. Every structure is custom built to meet specific requirements. All Delta-Star bus structures are factory engineered, factory assembled and factory tested before being shipped in units for simple and easy installation.

For complete details write or call our nearest district representative or our main office.

DELTA-STAR ELECTRIC COMPANY

2437 W. FULTON ST., CHICAGO 12, ILL.

DIVISION OF H. K. PORTER COMPANY, INC.

DISTRICT OFFICES IN ALL PRINCIPAL CITIES

CASE STUDY

Annual Savings in Turbine Lubricating Costs with Nonpareil Turbine Oil in a Midwest utility.

Turbine ..... 35,000 KW, 1800 RPM
Oil System Capacity .... 2800 gallons
Operation ... 1931 to 1937 on Turbine Oil X at 45¢ per gallon
Operation ... 1938 to 1948 on Nonpareil Turbine Oil at 87¢ per gallon
Annual Cost of Lubrication with Turbine Oil X ..... $ 911.57*
Annual Cost of Lubrication with Nonpareil Turbine Oil ... $ 284.13*
Annual Saving 68.8%

CASE STUDY

Annual Savings in Turbine Lubricating Costs with Nonpareil Turbine Oil on a large utility turbine.

Turbine ..... 80,000 KW, 1800 RPM
Oil System Capacity .... 8,000 gallons
Operation ... Dec. 1935 to April 1942, on Turbine Oil Y at 39¢ per gallon
Operation ... May 1942 to Jan. 1948 on Nonpareil Turbine Oil at 88¢ per gallon
Annual Cost of Turbine Lubrication with Turbine Oil Y .... $ 575.30*
Annual Cost of Lubrication with Nonpareil Turbine Oil .... $ 503.93*
Annual Saving 12.4%

CASE STUDY

Annual Savings in Turbine Lubricating Costs with Nonpareil Turbine Oil in a Midwest utility system.

Turbine ..... 20,000 KW (Now 30 years old)
Oil System Capacity .... 550 gallons
Operation ... June 1940 to Aug 1944, on Turbine Oil Z at 55¢ per gallon
Operation ... Oct 1944 to Oct 1948 on Nonpareil Turbine Oil at 89½¢ per gallon
Annual Cost of Lubrication with Turbine Oil Z ..... $ 83.90*
Annual Cost of Lubrication with Nonpareil Turbine Oil .... $ 69.49*
Annual Saving 17.2%

* Includes (1) cost of original fill—including interest charges, (2) oil replacements, (3) oil treating or sweetening, (4) cleaning turbine oil systems, (5) filter maintenance (where these items apply).

Turbine lubrication costs CUT... up to 68%

NONPAREIL
TRADE MARK
Turbine Oil

STUDIES have been made of typical utility company operations to determine how much the *price* of turbine oil affects the *cost* of turbine operation. Three such studies are summarized here. In each case, the price of the original fill of oil was 38% to 55% *less* than that for Nonpareil. But in each case the total annual cost for lubrication, when all factors are considered, shows a saving with Nonpareil.

You can find out how much Nonpareil will save on your lubricating costs. Standard Oil Lubrication Engineers have facts and figures to help you determine costs of Nonpareil lubrication for comparison with your present costs.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, to secure the services of the Engineer nearest you.

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